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ATTACHMENT 23

Superfund Record of Decision:
USAF Robins Air Force Base, GA
(EPA/ROD/R04-91/085)
June 1991

United States
Environmental Protection
Agency

Office of
Emergency and
Remedial Response

EPA/ROD/R04-91/085
June 1991



EPA Superfund Record of Decision:

USAF Robins Air Force Base, GA

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REPORT DOCUMENTATION PAGE		1. REPORT NO. EPA/ROD/R04-91/085	2.	3. Recipient's Accession No.	
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A. Supplementary Notes					
15. Abstract (Limit: 200 words) The 46.5-acre USAF Robins Air Force Base site is a logistics management and repair center for aircraft, missiles, and support systems in Warner Robins, Houston County, Georgia. The Zone 1 area, which includes a 45-acre inactive landfill and a 1.5-acre sludge lagoon is part of the 8,855-acre Robins Air Force Base. Land use in the area is mixed residential and industrial. A wetlands area borders the site to the east; in addition, part of the site lies within the 100-year floodplain of the Ocmulgee River. From 1965 to 1978, an onsite landfill (Landfill No. 4) was used for disposal of general refuse, and industrial and hazardous wastes. From 1962 to 1978, the sludge lagoon was used for disposal of wastewater treatment plant sludge and other liquid wastes. Types of wastes generated at the facility included electroplating wastes, organic solvents from cleaning operations, and pesticides, all of which were disposed of in the lagoon and landfill areas. Robins Air Force Base conducted a study in 1982 to identify and assess onsite hazardous waste disposal practices. Disposal areas were grouped into eight zones based on location and type of activity. Zone 1 has been divided into three operable units (OUs). This Record of Decision (ROD), which focuses on OU1, addresses the remediation of Landfill No. 4 and the sludge lagoon. Subsequent (See Attached Page)					
17. Document Analysis a. Descriptors Record of Decision - USAF Robins Air Force Base, GA First Remedial Action Contaminated Media: soil, sludge, gw Key Contaminants: VOCs (PCE, TCE), other organics (pesticides), metals (arsenic, chromium, lead) b. Identifiers/Open-Ended Terms					
c. COSATI Field/Group					
18. Availability Statement		19. Security Class (This Report) None		21. No. of Pages 58	
		20. Security Class (This Page) None		22. Price	

Abstract (Continued)

RODs will address remediation of the neighboring wetlands and surface waters (OU2) and the ground water adjacent to Landfill No. 4 and the sludge lagoon (OU3). The primary contaminants of concern affecting the soil and ground water are VOCs including PCE and TCE; and metals including arsenic, chromium, and lead.

The selected remedial action for this site includes treating 15,000 cubic yards of soil in the sludge lagoon using in-situ soil vapor extraction; removing volatile contaminants from the air using condensation, distillation, and carbon adsorption; controlling and treating landfill leachate; renovating the landfill cover; treating the sludge lagoon to remove VOCs, treating metals onsite in the sludge lagoon using solidification; onsite pumping and treatment of ground water; diverting surface water near the sludge lagoon; conducting long-term soil testing; and monitoring ground and surface water. The estimated present worth cost for this remedial action ranges from \$9,430,000 to \$14,000,000 with an annual O&M cost ranging from \$321,400 to \$334,400, depending on the components of the landfill cap.

PERFORMANCE STANDARDS OR GOALS: Contaminant-specific remediation goals have not been established for soil at the sludge lagoon because they are dependent on establishment of ground water goals, which will be developed in a subsequent ROD.

**U.S. AIR FORCE INSTALLATION
RESTORATION PROGRAM**

**SUPERFUND
RECORD OF DECISION**

**ROBINS AFB ZONE 1, GEORGIA
OPERABLE UNIT 1
SOURCE CONTROL**

JUNE, 1991

CONTENTS

SECTION

DECLARATION FOR THE RECORD OF DECISION

DECISION SUMMARY

- 1.0 Site Name and Location
- 2.0 Site History and Enforcement Activities
- 3.0 Highlights of Community Participation
- 4.0 Scope and Role of Operable Unit
- 5.0 Site Characteristics
- 6.0 Summary of Site Risks
- 7.0 Description of Alternatives
- 8.0 Summary of Comparative Analysis of Alternatives
- 9.0 Selected Remedy
- 10.0 Statutory Determinations

RESPONSIVENESS SUMMARY

- 1.0 Overview
- 2.0 Background on Community Involvement
- 3.0 Summary of Public Comment and Agency Response

**DECLARATION FOR THE
INTERIM ACTION RECORD
OF DECISION**

DECLARATION FOR THE INTERIM ACTION RECORD OF DECISION

SITE NAME AND ADDRESS

Zone 1 Robins Air Force Base
Operable Unit 1, Source Control
Warner Robins, Houston County, Georgia

STATEMENT OF PURPOSE

This Decision Document presents the selected remedial action for Operable Unit 1 of the Zone 1 Robins Air Force Base (AFB) Site, developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA), and to the extent practicable, the National Contingency Plan (NCP). This decision is based on the Administrative Record which is on file in the Directorate of Environmental Management office, Building 43, Robins AFB, Georgia, 31098.

This interim remedial action is taken to protect human health and the environment from the threat, while final remedial solutions are being developed.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from Zone 1, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present a current or potential threat to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

The Zone 1 Robins AFB site is divided into three operable units. Operable Unit 1 addresses Landfill No. 4 and the Sludge Lagoon and comprises source control. Operable Unit 2 addresses neighboring wetlands and surface waters and Operable Unit 3 addresses the groundwater beneath and adjacent to Landfill No. 4 and the Sludge Lagoon. The scope of this ROD is limited to Operable Unit 1.

The selected remedy for Operable Unit 1, source control, includes the following:

- Surface water run-on diversion
- Landfill No. 4 cover renovation including clearing, filling, regrading, addition of soil and clay cover material, and seeding
- Leachate control for Landfill No. 4 and treatment at Robins AFB
- Sludge Lagoon groundwater collection and treatment at Robins AFB
- Treatment of the Sludge Lagoon to remove Volatile Organic Compounds (VOCs), followed by solidification for the immobilization of metals

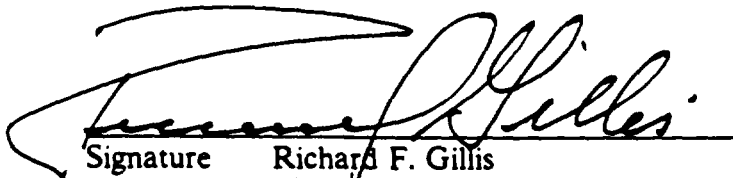
- Environmental monitoring to determine effectiveness of the remedial action

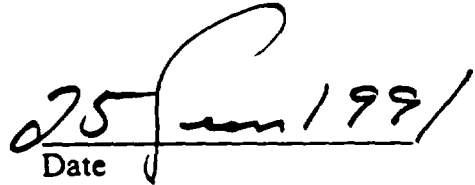
Further field investigations and treatability testing will be performed to refine design parameters for the cover renovation, leachate control system, the leachate and groundwater treatment systems, and the Sludge Lagoon treatment system.

STATUTORY DETERMINATIONS

The selected interim remedial actions are protective of human health and the environment, comply with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and are cost-effective. These interim remedial actions utilize permanent solutions and alternative treatment technologies to the maximum extent practicable for this site. The Sludge Lagoon soils and recovered groundwater and landfill leachate will be treated. However, the size of the landfill precludes excavation and treatment of all waste materials. Because this interim remedial action does not constitute the Final Remedy for the Site, the statutory preference for remedies as a principle element will be addressed by the Final response action.

Because hazardous substances will remain onsite in amounts above health based levels, a review will be conducted within 5 years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment. The review will be conducted to ensure that the remedy continues to provide adequate protection of human health and the environment.


Signature Richard F. Gillis
Major General, USAF
Commander, WR-ALC


Date

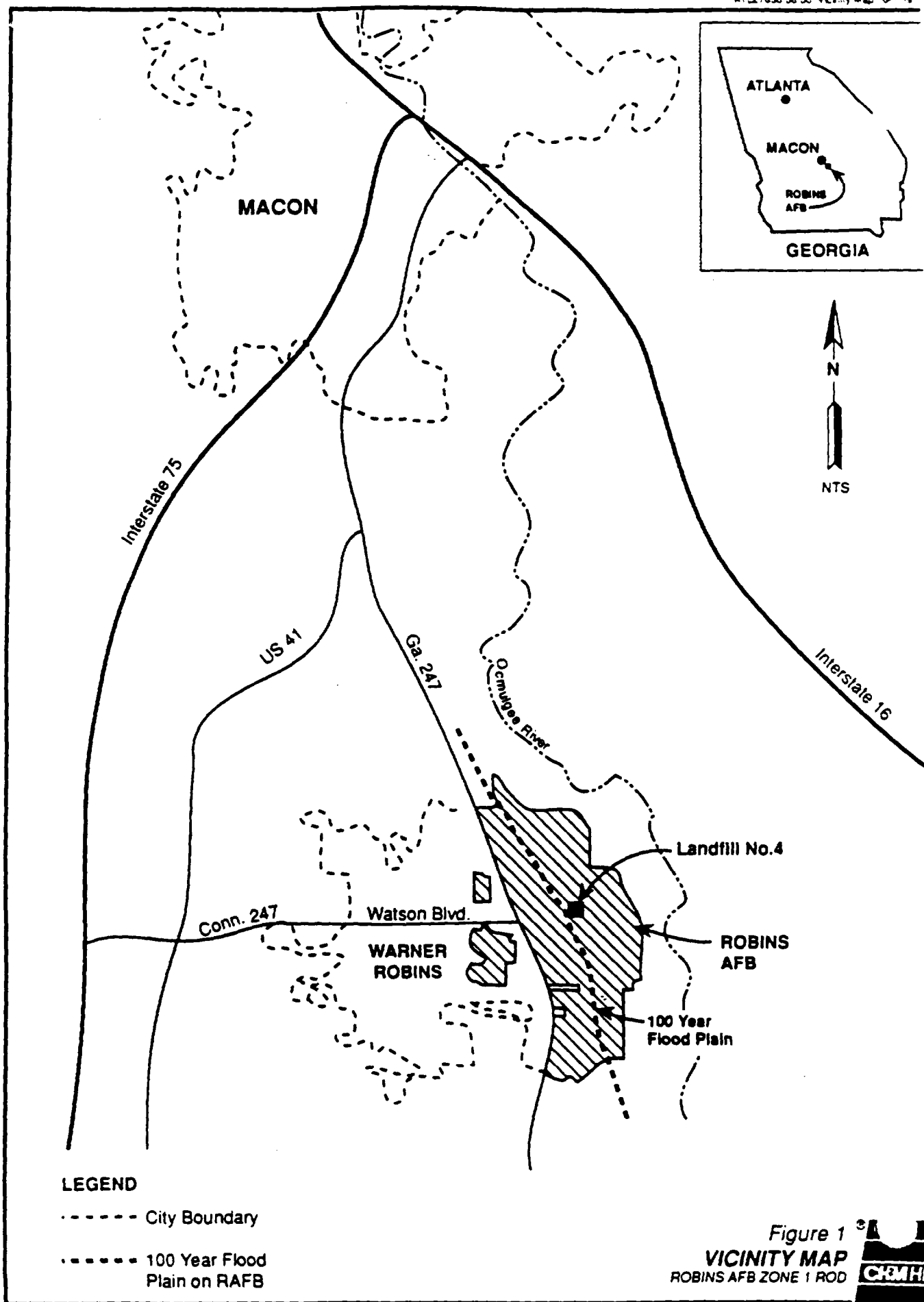
DECISION SUMMARY

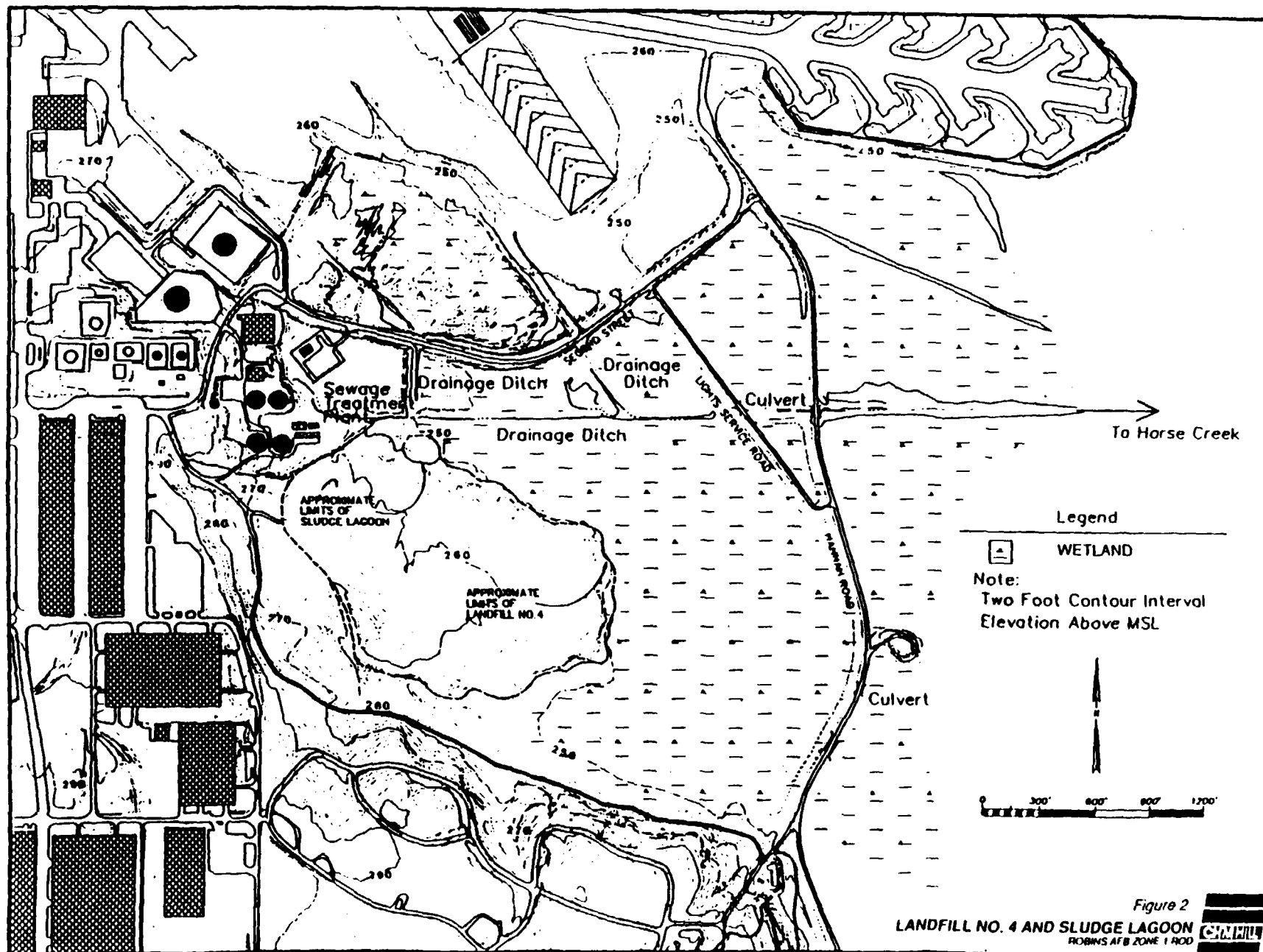
1.0 SITE NAME, LOCATION AND DESCRIPTION

Robins AFB is an active facility occupying 8,855 acres about 18 miles south of Macon, Georgia (Figure 1). Robins AFB is bounded on the immediate west by the City of Warner Robins, on the north by a housing subdivision in Houston County, on the south by unincorporated Bonaire, and on the east by the Ocmulgee River and its flood plain.

The Zone 1, Robins AFB, National Priority List (NPL) site is located approximately 4,500 feet east of Georgia Highway 247 in the central portion of the base (Figure 2). Zone 1 consists of Landfill No. 4, which covers 45 acres, and an adjacent 1.5-acre sludge lagoon (Figure 2).

Zone 1 is located adjacent to a bluff that forms the western boundary of the Ocmulgee River flood plain. The flood plain extends about 1 to 2 miles eastward to the river. Landfill No. 4 was originally constructed by disposing of fill material into the flood plain and wetland area from the bluff and advancing to the east. The Sludge Lagoon was constructed on the northern boundary of Landfill No. 4 by excavating and building earthen dikes. Surface water at Robins AFB generally drains from west to east into the Ocmulgee River flood plain.





2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

Robins AFB currently serves as a worldwide logistics management center for aircraft, missiles, and support systems and is a major repair center for aircraft and airborne electronic systems.

Robins AFB has generated various types of solid wastes over the years, including refuse and hazardous wastes. The hazardous wastes include electroplating wastes containing heavy metals and cyanide, organic solvents from cleaning operations and fire training exercises, and off-specification chemicals such as pesticides.

In 1982, Robins AFB conducted a basewide survey to identify and assess past hazardous waste disposal practices. Disposal areas were grouped into eight zones based primarily on location and type of disposal activity. Zone 1 (Landfill No. 4 and the Sludge Lagoon) was considered to have the highest potential for migration of hazardous substances and as a result was placed on the CERCLA NPL by the U.S. Environmental Protection Agency (EPA) in 1987. Landfill No. 4 reportedly operated from 1965 until 1978 for disposal of general refuse and industrial wastes. The Sludge Lagoon was used for disposal of industrial wastewater treatment plant sludges and other liquid wastes from 1962 to 1978. The Landfill and the Sludge Lagoon were both closed and covered with clean fill in 1978.

In June of 1989 Robins AFB entered into a Federal Facilities Agreement with the Georgia Department of Environmental Protection (GEPD) and the EPA to establish a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions at the site in accordance with CERCLA, the NCP, Superfund guidance and policy, Georgia Hazardous Waste Management Act (GHWMA).

The following reports describe the results of investigations at Zone 1 to date:

Law Engineering Testing Company. *Final Report—Groundwater Monitoring Program: Landfill Closure—Robins Air Force Base.* Warner Robins, Georgia, for C. T. Bone, Inc., 1980.

Water and Air Research, Inc. *Installation Restoration Program Phase II—Confirmation/Quantification, Stage 1, Final Report.* March 1985.

HAZWRAF. U.S. Air Force Installation Restoration Program Phase IVA. *Remedial Action Plan for Source Control at Zone 1, Landfill No. 4 and Sludge Lagoon, Site Characterization, Task 2A.* Robins AFB, Georgia. March 25, 1987a.

HAZWRAF. U.S. Air Force Installation Restoration Program Phase IVA. *Remedial Action Plan for Source Control at Zone 1, Landfill No. 4 and Sludge Lagoon, Additional Site Investigations, Task 2C.* Robins AFB, Georgia. September 4, 1987b.

Engineering-Science. *Installation Restoration Program Phase II—Confirmation/Quantification, Stage 2, Final Report.* June 1988.

HAZWRAP. U.S. Air Force Installation Restoration Program Phase IVA. *Remedial Investigation Zone 1, Additional Site Investigations at Zones 1 and 5, Task S2 Report.* Robins AFB, Georgia. November 1988.

HAZWRAP. U.S. Air Force Installation Restoration Program Phase IVA. *Remedial Investigation Zone 1.* Robins AFB, Georgia. May 1990.

HAZWRAP. U.S. Air Force Installation Restoration Program Phase IVA. *Feasibility Study, Landfill No. 4 and Sludge Lagoon Source Control, Operable Unit 1, Zone 1.* Robins AFB, Georgia. February 1991.

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

The Remedial Investigation (RI) for the Robins AFB Zone 1 Operable Unit 1—Source Control Remedy was released to the public in May 1990 and the FS in April 1991. The Proposed Plan was released on April 25, 1991 for public comment. These documents were made available to the public in the Administrative Record located at the Directorate of Environmental Management, Building 43, Robins AFB and at the Environmental Information Repository at the Nola Brantley Memorial Library in Warner Robins. The notice of availability of these documents was published in the *Warner Robins Daily Sun* and the *Macon Telegraph* on April 21, 1991. A public comment period was held from April 25 to June 10, 1991. In addition, a public meeting was held on May 8, 1991. At this meeting, representatives of Robins AFB, EPA and the GEPA answered questions about the site and the remedial alternatives under consideration. A response to the comments received during this period is included in the Responsiveness Summary, which is part of this Record of Decision.

The proposed plan identified the preferred remedy for Landfill 4 as a variation of Alternative 2, from the Feasibility Study (FS) (see Section 7); landfill cover renovation with clay addition, leachate control and treatment and Sludge Lagoon groundwater collection and treatment. It also identified Alternative 2, Soil Vapor Extraction for Removal of VOCs Followed by Solidification for Immobilization of Metals, as the preferred alternative for the Sludge Lagoon. Robins AFB, U.S. EPA and GEPA reviewed all written and verbal comments submitted during the public comment period. Upon review of these comments, it was determined that no significant changes to the Proposed Plan preferred remedy were necessary.

4.0 SCOPE AND ROLE OF OPERABLE UNIT 1

The overall strategy of Zone 1 is divided into three operable units. The interim remedial actions selected in this ROD are applicable to operable Unit 1. Further investigations are underway for operable Units 2 and 3.

Operable Unit 1 is directed at the known source of contamination, Landfill No. 4 and the Sludge Lagoon, and interim remedial actions for reducing migration of the groundwater contamination near the Sludge Lagoon. The final remedy for the groundwater will be proposed following Operable Unit 3 work. Operable Unit 2 is directed at determining the degree of impact that may have occurred in the wetlands area and surface waters from the known source of contamination in Operable Unit 1 and remediation of the impacts identified. Operable Unit 3 is directed at determining the degree of impact that may have occurred in the groundwater beneath and adjacent to Landfill No. 4 and the Sludge Lagoon and remediation of impacts identified.

The known sources of contamination in Zone 1 are Landfill No. 4 and the Sludge Lagoon. The Sludge Lagoon is estimated to contain 50 percent of the total Zone 1 contamination and appears to be contributing to groundwater contamination.

The overall strategies of the selected remedy for Landfill No. 4 and groundwater below and immediately adjacent to the Sludge Lagoon are:

- Control hazardous substances releases
- Minimize the potential direct exposure to hazardous substances
- Control the releases of hazardous substances to the groundwater near the Sludge Lagoon

These strategies would be achieved primarily by the reduction in mobility of hazardous substances through containment with treatment of Landfill No. 4 leachate and groundwater near the Sludge Lagoon. The groundwater contamination would not be fully remedied but will be addressed in Operable Unit 3.

The overall strategies addressed by the selected remedy for the Sludge Lagoon are:

- Control hazardous substances releases
- Minimize the potential of direct exposure to hazardous substances

These objectives are achieved by the reduction in mobility of hazardous substances by containment with treatment. Groundwater contamination beyond the sludge lagoon area will be addressed in a subsequent operable Unit 3 remedial action.

These interim remedial actions will be consistent with any planned future actions, to the extent possible.

5.0 SUMMARY OF SITE CHARACTERISTICS

5.1 GEOLOGY

Robins AFB is underlain by Cretaceous and Quaternary sediments about 350 feet thick. The Cretaceous deposits are divided into the following four geologic formations: the Providence, the Ripley, the Cusseta, and the Blufftown (Figure 3). The Providence and Ripley formations tend to act as one hydrologic unit and are referred to in this report as the Providence formation. The Providence Formation consists of beds of sand, gravelly sand, silty sand, and clay. The formation is saturated and yields large quantities of water. Beneath Zone 1 and the eastern portion of the base, the Providence formation is overlain by Quaternary alluvial deposits (peat, clay, and gravel), which comprise the flood plain of the Ocmulgee River.

The Cusseta Formation, composed of about 15 to 50 feet of dense plastic clay and sand, is saturated but yields little water to wells and is believed to act as a confining or semiconfining bed. The Blufftown Formation consists of saturated sand and gravel beds and is underlain by metamorphic basement rocks. It yields significant quantities of water to wells and is the primary Robins AFB and local water supply aquifer. The metamorphic rocks beneath the Blufftown generally will not yield water and are not considered further in this report.

5.2 HYDROGEOLOGY

The groundwater flow system above the Cusseta Formation at Zone 1 is separated into the saturated surficial fill, the Quaternary aquifer, and the upper and lower Providence aquifers.

The regional groundwater flow direction within the Cretaceous deposits is from west to east, generally toward the Ocmulgee River. Water in the Quaternary aquifer also generally flows toward the river. Where the Ocmulgee River has eroded part of the Cretaceous sediments, there is a significant upward gradient from the deeper units toward the Quaternary unit and surface waters. The Ocmulgee River flood plain is a broad discharge area for groundwater.

The groundwater flow pattern beneath Zone 1 has been altered. Runoff from a large area of the base flows onto Landfill No. 4. This water infiltrates and saturates the landfill waste mass. As a result a mounded water table has been established within the landfill, creating a local flow system in the surficial fill where landfill leachate and lagoon groundwater flow radially to the north, northeast, and east, ultimately discharging into the adjacent wetlands (Figure 4).

5.3 GEOTECHNICAL CHARACTERISTICS

The peat and clay bed directly underlying the eastern two thirds of landfill wastes consists of a clay bed overlain by peat constituting a total thickness of 5 to 14 feet. Split-spoon samples of the clay showed it to be generally a plastic material penetrated with roots and channels.

Laboratory permeability measurements of the clay bed were approximately 10^{-8} cm/s, whereas earlier field permeability studies indicated that values averaged

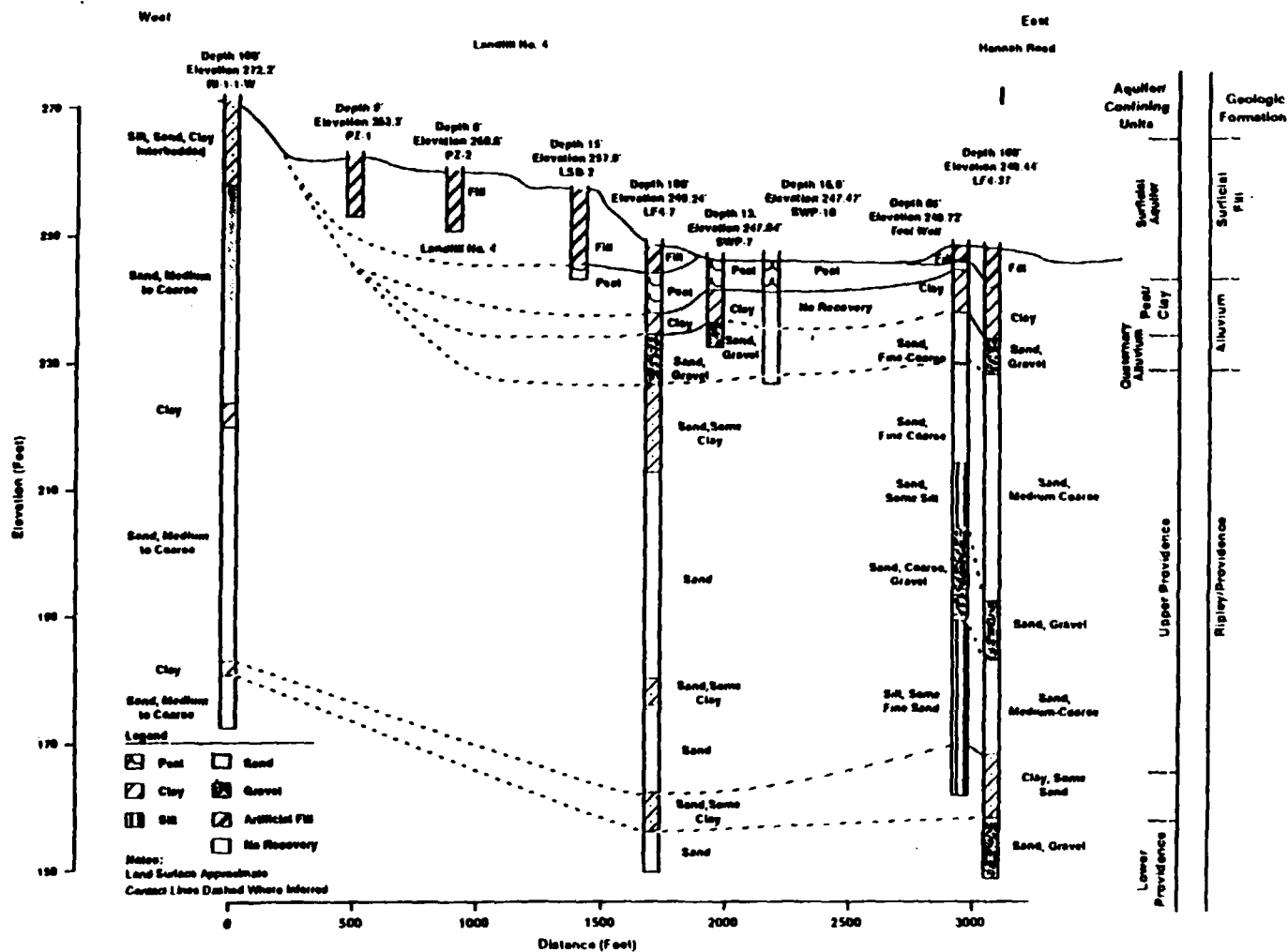
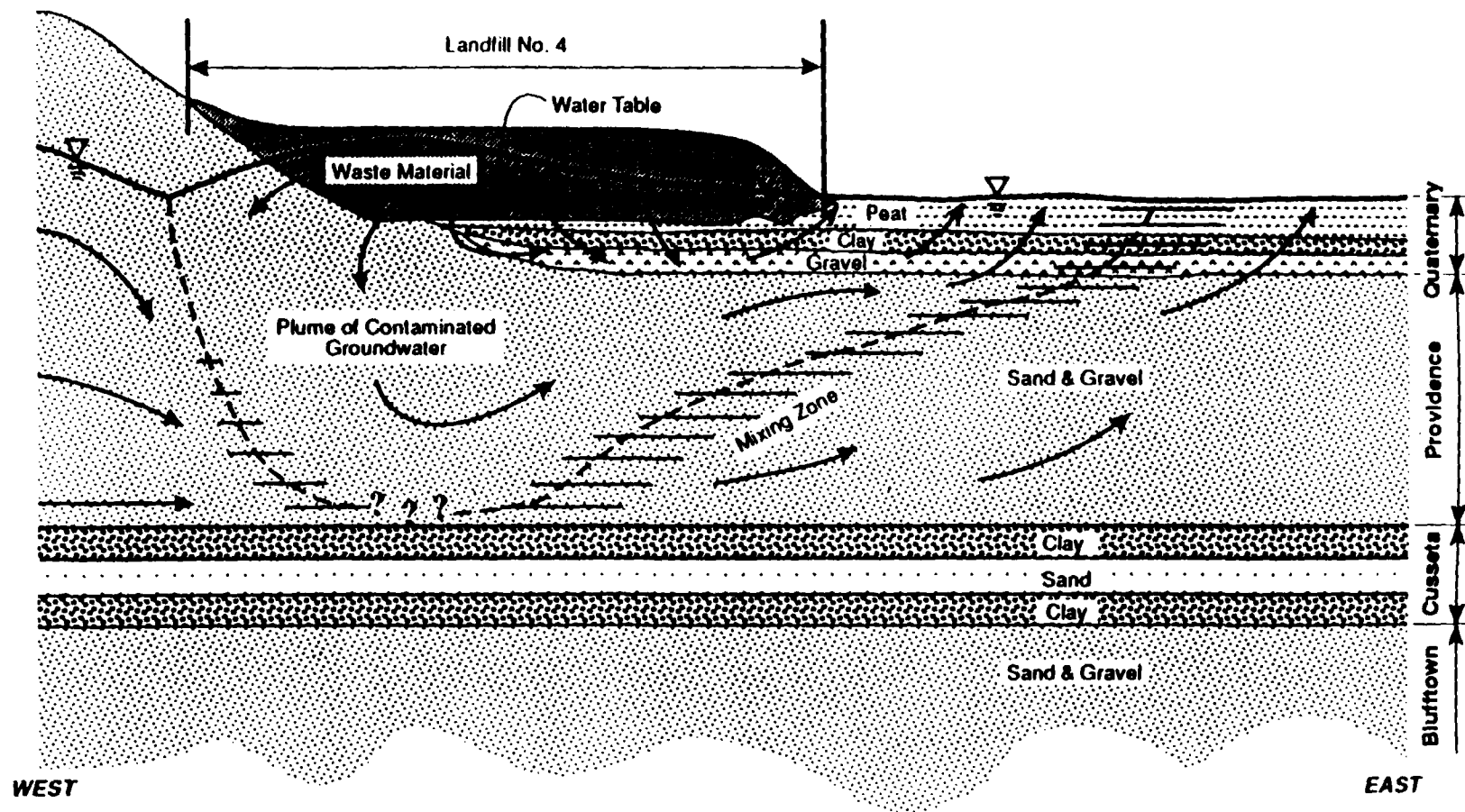


Figure 3
EAST-WEST LITHOSTRATIGRAPHIC
CROSS SECTION
FOUNDED BY ZONE 1 (1981)



LEGEND

- Groundwater Flow
- Boundary of Plume of Contaminated Groundwater
- Mixing Zone Between Plume and Natural Waters

Not to Scale

Figure 4
**SCHEMATIC DIAGRAM OF CONCEPTUAL
 GROUNDWATER FLOW SYSTEM**
 ROBINS AFB ZONE 1 ROD



approximately 10^{-4} cm/s (LETCO 1980). Differences between laboratory and field test results are attributed to larger scale discontinuities in the stratum (e.g., seams, joints, root holes) not measured by laboratory methods. Thus, higher permeabilities indicated from field tests are believed to be more representative of the actual permeability in the peat and clay bed.

Within the eastern two-thirds of the landfill and the Sludge Lagoon the peat and clay beds appear to retard flow of leachate into the underlying aquifers. Where the peat and clay beds are absent from beneath the landfill, under the western third, the wastes are lying directly upon the sands of the Providence Formation, and there is no impedance to leachate flow out of the wastes.

Sands underlying the western end of the landfill and below the peat and clay bed constitutes the most significant groundwater aquifer at the site, extending to depths of several hundred feet. Field investigations using slug tests and observation of shallow well pumping indicated a hydraulic conductivity in the Providence of 10^{-2} to 10^{-3} cm/s. Laboratory permeability values varied between 6×10^{-4} and 9×10^{-3} cm/s for disturbed samples compacted to relative densities of 60 and 90 percent.

The existing soil cap over the landfill varies in thickness from almost non-existent to as much as 4-feet thick. The material is nonplastic, silty or clayey sand having less than 25 percent silt or clay. The average field permeability of this layer was measured as 3×10^{-4} cm/s with a laboratory permeability of 2×10^{-5} to 5×10^{-6} cm/s.

5.4 NATURE AND EXTENT OF CONTAMINANTS

The nature, extent, and concentration of hazardous substance contamination in the landfill and sludge lagoon area were studied in detail during a field sampling investigation (Robins AFB 1987) and the Remedial Investigation Zone 1 (Robins AFB 1989). The following summarizes the major observations from the previous investigations.

5.4.1 Contaminants of Concern

Hazardous substances detected in soil, sludge, and groundwater samples from the site are listed in Table 1. To provide a focus for remedial action goals, contaminants of concern were identified in the Baseline Risk Assessment of the RI report. The following factors were considered in the selection of contaminants of concern:

- Concentration and frequency of occurrence
- Distribution in the groundwater and other media at the site
- Regulatory criteria and toxicity
- Identified contribution to risks in media other than groundwater

The contaminants of concern identified for Zone 1 are:

- Trichloroethene
- 1,2-Dichloroethene
- Vinyl chloride
- Tetrachloroethene
- Carbon tetrachloride

Table 1. Compounds Detected in Zone 1

Volatile Organic Compounds	Semivolatile Organic Compounds	Inorganic Constituents	Pesticides	PCBs
Vinyl Chloride	Phenol	Aluminum	Dieldrin	PCB-1254
Methylene Chloride	2-methylphenol	Antimony	Aldrin	PCB-1260
Acetone	4-methylphenol	Arsenic	4,4-DDE	
1,1-dichloroethene	1,3-dichlorobenzene	Barium	4,4-DDD	
1,2-dichloroethene	1,2-dichlorobenzene	Beryllium	4,4-DDT	
Chloroform	1,4-dichlorobenzene	Cadmium	Alpha Chlordane	
1,1-dichloroethane	Pentachlorophenol	Calcium	Gamma Chlordane	
1,2-dichloroethane	Di-N-octyl-phthalate	Chromium	Technical Chlordane	
1,1,1-trichloroethane	Bis(2-ethylhexyl)phthalate	Cobalt	Heptachlor	
Carbon Tetrachloride	Benzoic Acid	Copper	4,4-methoxychlor	
Trichloroethylene	Bis(2-chloroisopropyl)ether	Iron		
Benzene	Naphthalene	Lead		
Tetrachloroethene	2-methylnaphthalene	Magnesium		
Chlorobenzene	N-nitrosodiphenylamine	Manganese		
Total Xylenes	Dibutyl Phthalate	Mercury		
2-butanone	Pyrene	Nickel		
4-methyl-2-pentanone	Butylbenzyl Phthalate	Potassium		
Trichlorofluoromethane	Dibenzofuran	Selenium		
1,1,2,2-tetrachloroethane	Chrysene	Silver		
2-hexanone	Benzo(g,h,i)perylene	Sodium		
Bromodichloromethane	Indeno(1,2,3-c,d)pyrene	Thallium		
Dibromochloromethane	Benzo(k)phenanthrene	Vanadium		
Chloromethane	4-chloro-3-methylphenol	Zinc		
Carbon Disulfide	Benzo(a)pyrene	Cyanide		
Cis-1,3-dichloropropene	Benzo(b)fluoranthene	Amenable Cyanide		
1,2-dichloropropane	Fluoranthene	Sulfides		
Toluene	Anthracene			
Ethyl Benzene	Phenanthrene			

GLT985/043.51

- Lead
- Arsenic
- Cadmium
- Chromium

A summary of the number of samples with detections and the concentrations found are presented in Tables 2 and 3 for each of the contaminants of concern. The compounds most widely distributed and at the highest levels in both soil and groundwater included VOCs and metals. Of the contaminants of concern identified in the RI, lead and trichloroethene (TCE) were the most widely distributed and typically at higher concentrations than other constituents. They are considered to be representative of the distribution of organic and inorganic constituents at the site.

5.4.2 Zone 1—Contaminant Sources

The highest concentrations of metals and VOCs occur in the Sludge Lagoon. Maximum concentrations of VOCs and metals in the Sludge Lagoon were detected in samples collected from a depth of 8 to 10 feet. High concentrations of contaminants were also detected in leachate samples from the Sludge Lagoon. Contaminant concentrations decreased in soils nearer the surface of the Sludge Lagoon.

Concentrations of contaminants detected in soils and leachate in the landfill were generally one to two orders of magnitude lower than concentrations in the Sludge Lagoon. The surface soil samples collected during the RI indicate that the landfill cover is generally uncontaminated, although localized "hot spots" may exist.

5.4.3 Groundwater Contamination

Concentrations of hazardous substances in groundwater migrating from the landfill and especially the Sludge Lagoon are highest in the Quaternary alluvium. Contaminants in the Quaternary alluvium also demonstrate the greatest lateral migration. As the contaminants migrate away from the source areas, the concentrations generally decrease. The general groundwater migration pathway appears to be to the north and northeast toward the drainage channel and to the wetlands east and northeast of the source areas. Hannah Road is approximately the downgradient limit for waste migration in the groundwater from Zone 1.

The distribution of lead in the Quaternary aquifer is shown in Figure 5. Lateral migration of lead in the Quaternary aquifer near the Sludge Lagoon is evident. Lead may have migrated 400 feet beyond the eastern edge of the landfill. The potential lead plume is bounded to the east by several monitoring wells where lead was not detected. Samples from several wells along Second Street (Figure 5) revealed lead concentrations that could be from sources other than Zone 1. Similarly, samples from wells along Hannah Road had lead concentrations that indicate that either naturally occurring lead is present or local sources of lead contamination are present in the vicinity of the road within the wetland. The vertical distribution of lead across Zone 1 is shown in Figure 6. This vertical interpretation is based on RI data and assumptions using the conceptual groundwater flow model.

The distribution of TCE in the Quaternary aquifer is shown in Figure 7. Lateral migration of TCE in the Quaternary aquifer is similar to the migration of lead except

Table 2 Contaminants of Concern
Found in Soils
Robins Air Force Base
Page 1 of 1

Contaminant of Concern	Surface Soils			Sludge Lagoon Borings			Landfill Borings			Sediments		
	Frequency of Detection	Maximum Concentration	Geometric Mean Concentration	Frequency of Detection	Maximum Concentration	Geometric Mean Concentration	Frequency of Detection	Maximum Concentration	Geometric Mean Concentration	Frequency of Detection	Maximum Concentration	Geometric Mean Concentration
Carbon tetrachloride (ug/kg)	--			--			--			--		
1,2-Dichloroethene (ug/kg)	--			9/23	100,000	22.5	--			--		
Tetrachloroethene (ug/kg)	--			5/23	50,000	12.9	--			1/27	33.0	
Trichloroethylene (ug/kg)	--			3/23	2,500,000	13.5	--			3/27	32	7.63
Vinyl chloride (ug/kg)	--			1/23	110		--			--		
Arsenic (mg/kg)	6/13	1.90	0.530	22/23	45.0	9.84	14/14	12.0	5.29	19/27	27.2	1.57
Cadmium (mg/kg)	1/13	16.7		20/23	599	7.33	13/14	15.0	3.71	6/27	21.00	1.77
Chromium - Total (mg/kg)	12/13	153	5.43	23/23	6,419	73.8	14/14	52.0	19.1	24/27	230	14.7
Lead (mg/kg)	13/13	122	4.36	22/23	972	107	14/14	155	36.1	27/27	226	28.1

-- = Not Detected

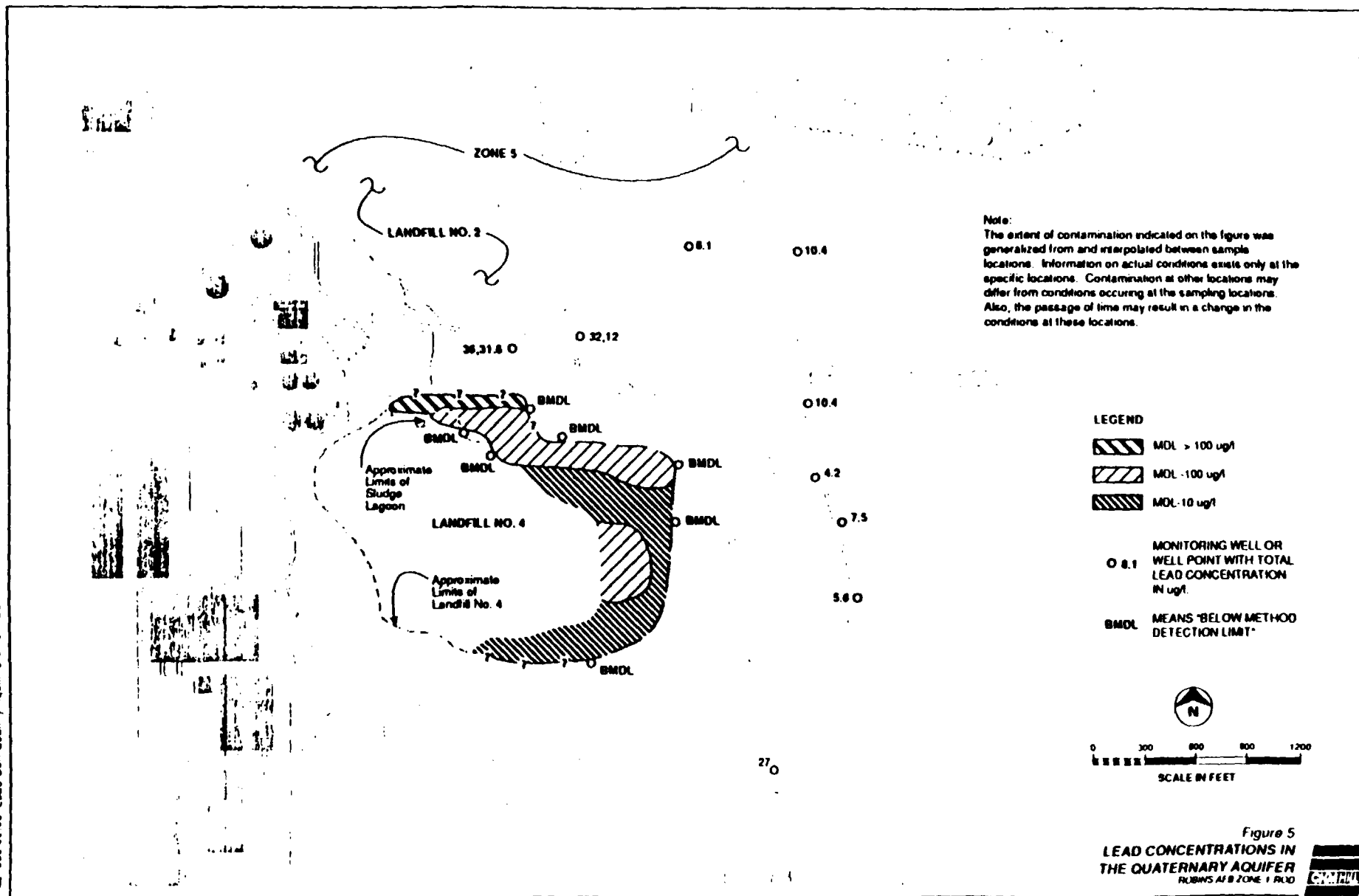
**Table 3 Contaminants of Concern
Found in Water
Robins Air Force Base
Page 1 of 1**

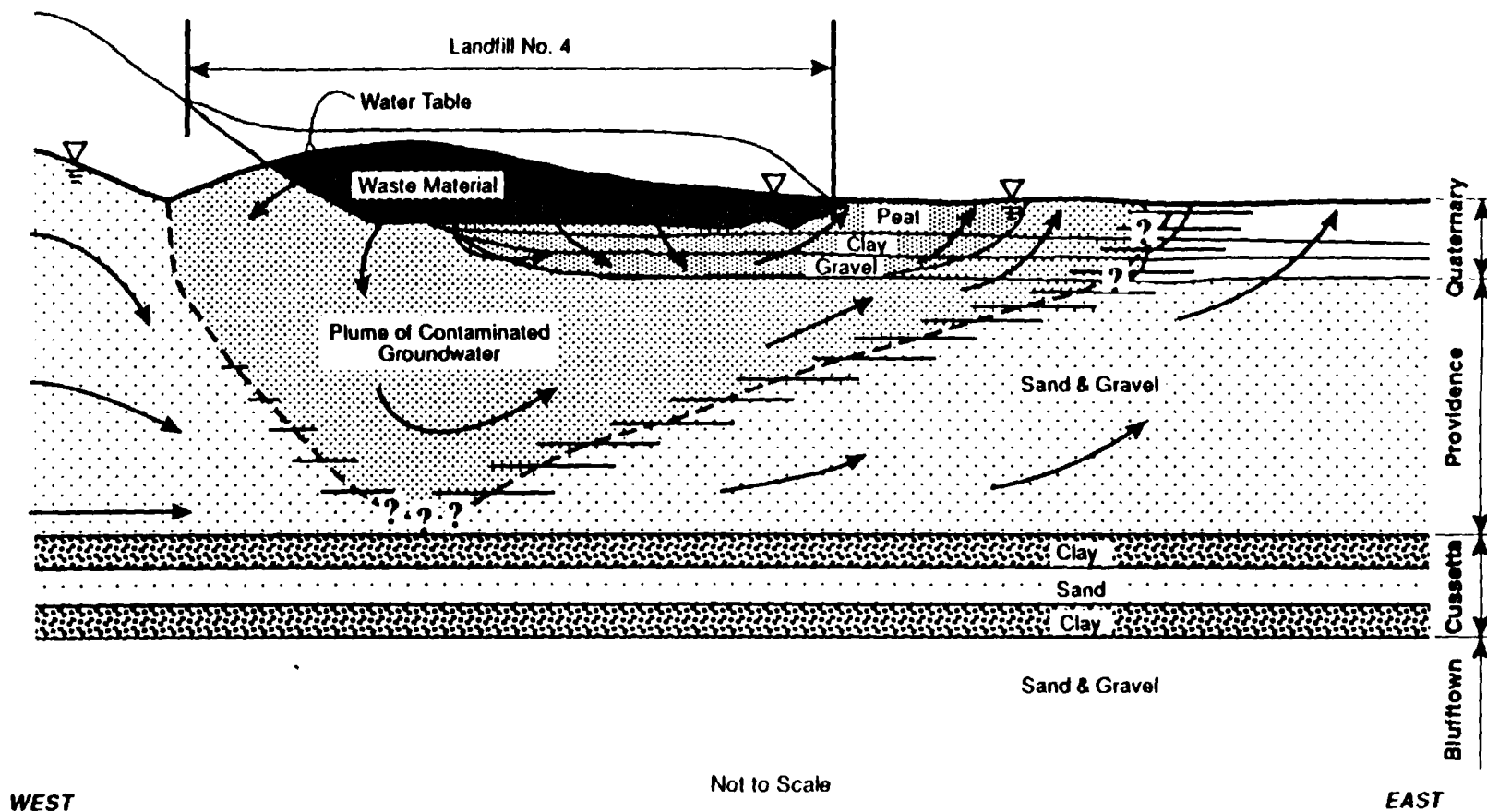
Contaminant of Concern	Sludge Lagoon Leachate			Landfill Leachate			Groundwater			Surface Water		
	Frequency of Detection	Maximum Concentration	Geometric Mean Concentration	Frequency of Detection	Maximum Concentration	Geometric Mean Concentration	Frequency of Detection	Maximum Concentration	Geometric Mean Concentration	Frequency of Detection	Maximum Concentration	Geometric Mean Concentration
Carbon tetrachloride (ug/l)	--			--			25/121	110	5.16	--		
1,2-Dichloroethene (ug/l)	6/9	36,000	28.3	3/15	31	3.97	27/121	19,000	5.85	3/12	1.0	
Tetrachloroethene (ug/l)	4/9	1,100	21.3	--			20/121	280	5.40	--		
Trichloroethylene (ug/l)	6/9	130,000	30.9	4/15	8.10	2.70	48/121	21,000	10.8	9/12	7.00	
Vinyl chloride (ug/l)	5/9	12,000	37.9	3/15	12.0	3.50	8/121	6,700	7.57	--		
Arsenic (ug/l)	6/6	21,000	652	14/14	13,000	637	19/112	109	2.12	3/11	12.0	2.45
Cadmium (ug/l)	6/6	34,800	4,534	14/14	9,300	279	9/112	600	2.57	5/11	128	7.22
Chromium - Total (ug/l)	6/6	13,163,000	13,851	14/14	66,000	1,085	41/112	2,720	6.35	6/11	1,390	19.9
Lead (ug/l)	5/6	60,000	5,880	14/14	10,400	2,478	73/112	5,240	5.63	7/11	1,400	25.2

-- = Not Detected

POOR QUALITY
ORIGINAL

27856 08 00 Lead Con Quaternary Aquifer 5-31-91VLO





LEGEND

- Groundwater Flow
- Boundary of Plume of Contaminated Groundwater
- Mixing Zone Between Plume and Natural Waters

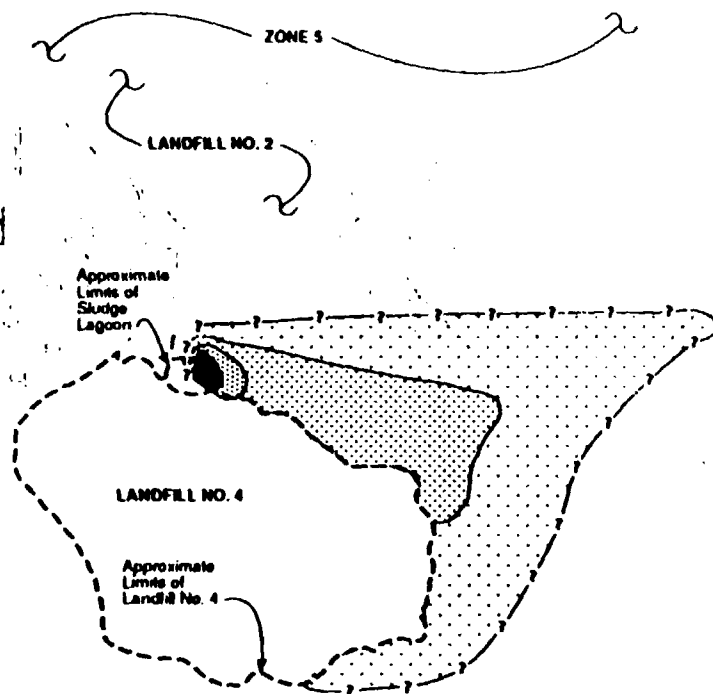
LEAD CONCENTRATIONS

- >1,000 ug/l
- 20-100 ug/l
- 10-20 ug/l
- <10 ug/l

Figure 6
DISTRIBUTION OF LEAD
 UNDERNEATH THE LANDFILL
 ROBINS AFB ZONE 1 ROD



FOOT COPY
ORIGINAL



Note:
The extent of contamination indicated on the figure was generalized from and interpolated between sample locations. Information on actual conditions exists only at the specific locations. Contamination at other locations may differ from conditions occurring at the sampling locations. Also, the passage of time may result in a change in the conditions at these locations.

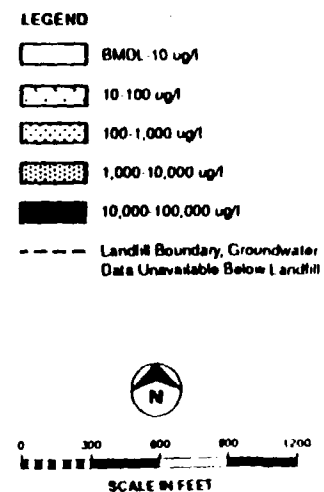


Figure 7
ZONE 1 TCE CONCENTRATIONS IN THE
QUATERNARY AQUIFER
RUBENS AFB ZONE 1 ARO



that the plume appears to extend farther to the east, to the creek at Hannah Road. TCE was detected in three wells north and northwest of the Sludge Lagoon and Landfill No. 4. TCE in groundwater at these wells could be from Zone 5, the industrial area TCE contamination, and from Zone 1. Portions of the TCE plume boundary in Figure 7 are shown as questionable to represent the uncertainty of the TCE sources. The vertical distribution of TCE across Zone 1 is shown schematically in Figure 8. This vertical interpretation considers the RI data, possible input from other upgradient sources, and assumptions using the conceptual groundwater flow model.

The concentration of contaminants generally decreases about one order of magnitude downward from the waste sources; i.e., the concentration of contaminants in the Quaternary gravel is about one order of magnitude less than in the adjacent waste mass. This trend also applies to deeper monitoring zones; i.e., the contaminant levels in monitoring wells in the upper Providence Formation are generally one order of magnitude less than the concentration of similar contaminants in adjacent overlying Quaternary gravel monitoring wells, and concentrations in the lower Providence Formations are roughly an order of magnitude lower than those in the upper Providence Formation.

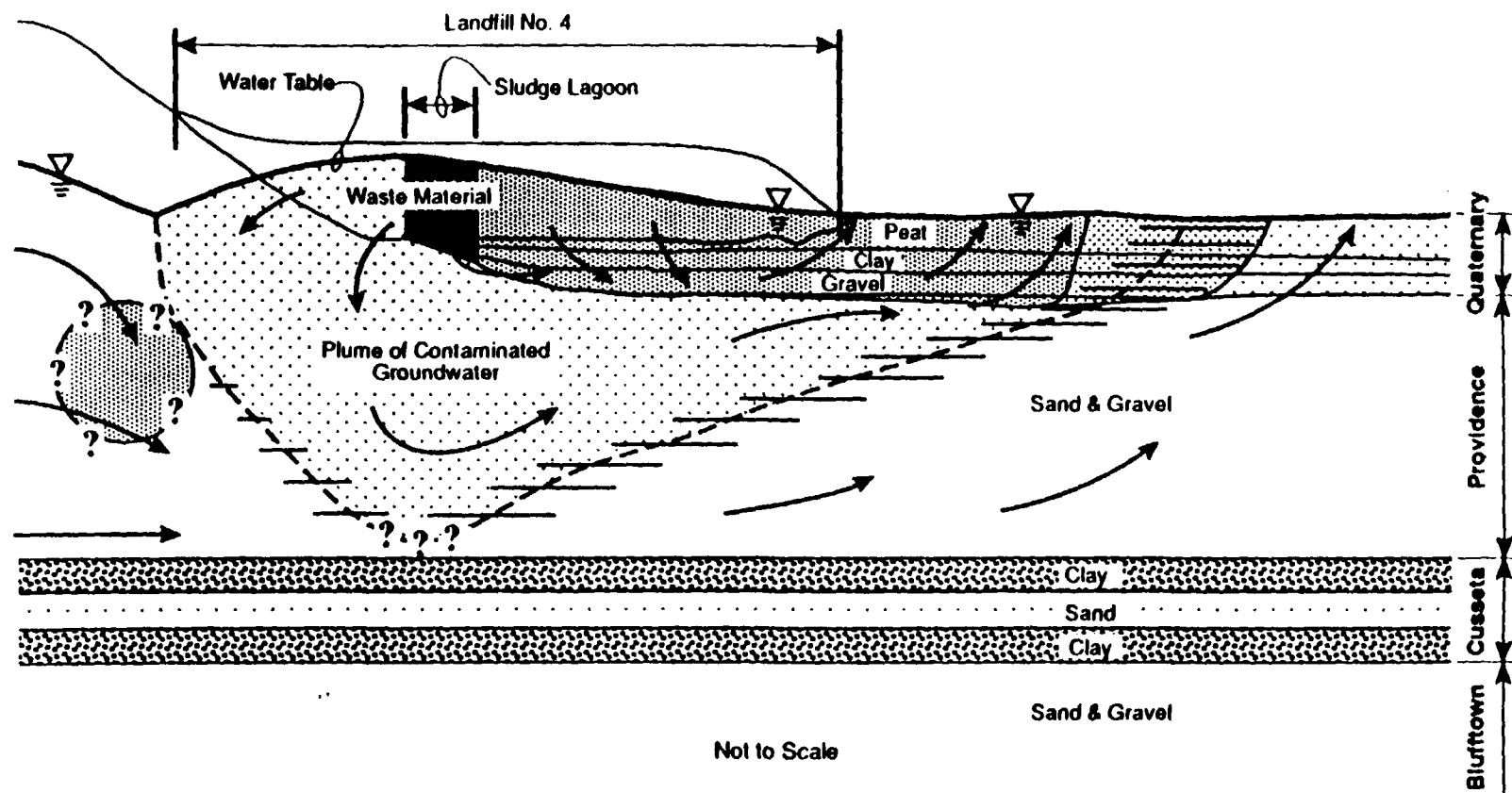
In the vicinity of the Sludge Lagoon, the concentration of contaminants in the source is elevated such that contamination migrating downward within the tested depths is not diluted or attenuated to concentrations below detection limits. To represent surficial contamination, the concentration and distribution of lead in the saturated surficial fill is shown in Figure 9. As a result of downward migration from the surficial zone, contamination has been detected deeper in groundwater near the Sludge Lagoon than anywhere else in Zone 1. Based on very limited data, it appears that hazardous substances may have migrated as far down as the lower Providence aquifer on the north side of the lagoon. However, it is unknown whether these substances might have migrated from other sources due to limited background information.

No monitoring well has been placed in Landfill No. 4 or the Sludge Lagoon through the peat and clay layer, so the vertical extent of contaminant migration directly beneath the sources has not been measured. The Cusseta Formation is believed to be a confining bed and most likely inhibits downward migration of contaminants beneath the site.

Robins AFB water supply Well No. 3 is located about 1,500 feet northwest of Zone 1. The well has been removed from service. Water in the well contains low levels (less than drinking water standards) of contaminants. The contaminants include some of the same contaminants as those that occur in the groundwater in Zone 1. Contaminant sources upgradient of Well No. 3, and closer to it than Zone 1, are more likely sources of the contamination than Zone 1, but this has not been completely evaluated. The Robins AFB industrial area TCE contamination and its potential sources are being investigated as part of the Resource Conservation and Recovery Act (RCRA) facility investigations.

WEST

EAST



LEGEND

- Groundwater Flow
- Boundary of Plume of Contaminated Groundwater
- Mixing Zone Between Plume and Natural Waters

TCE CONCENTRATIONS

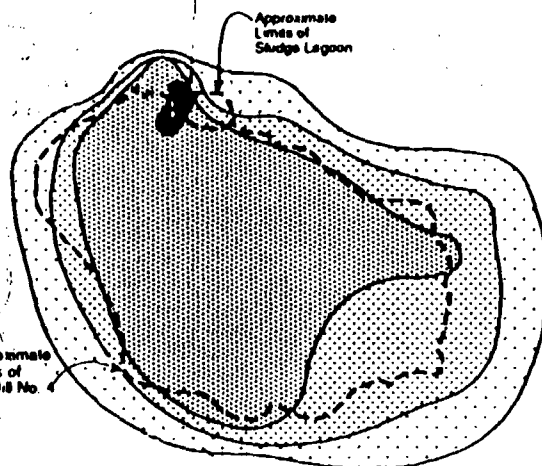
- 1,000-20,000 ug/l
- 100-1,000 ug/l
- 10-100 ug/l
- MDL-10ug/l
- BMDL

NOTE: Groundwater contamination below landfill based on data north of landfill near sludge lagoon.

Figure 8
DISTRIBUTION OF TCE
UNDERNEATH ZONE 1
ROBINS AFB ZONE 1 ROD



POOR
ORIGINAL



Note:
The extent of contamination indicated on the figure was generalized from and interpolated between sample locations. Information on actual conditions exists only at the specific locations. Contamination at other locations may differ from conditions occurring at the sampling locations. Also, the passage of time may result in a change in the conditions at these locations.

LEGEND

- BMDL-10 ug/l
- ▨ 10-100 ug/l
- ▤ 100-1,000 ug/l
- ▥ 1,000-10,000 ug/l
- 10,000-100,000 ug/l
- - - LANDFILL BOUNDARY



0 300 600 900 1200
SCALE IN FEET

Figure 9
LEAD CONCENTRATIONS IN SOURCE
BORINGS AND SURFICIAL GROUNDWATER
BORINGS AT B-2 (TIME 1 YEAR)

Available data on the Robins AFB water supply wells indicate that they are completed in the Blufftown Formation, but some wells have multiple completion zones that may include more than the Blufftown Formation. Because of this uncertainty, it is possible that supply Well No. 3 (and other Robins AFB wells) is completed in more than one aquifer.

6.0 SUMMARY OF SITE RISKS

The risk assessment (Robins AFB, 1990) evaluates potential risks to human health and the environment from actual or threatened releases from Zone 1 at Robins AFB, Georgia.

In summary, actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present a current or potential threat to public health, welfare, or the environment.

6.1 EXPOSURE ASSESSMENT

Risks are estimated for two potential pathways: ingestion and inhalation of contaminated media or waste. A number of conservative assumptions and procedures were used in the risk calculations. The three most important ones were the use of maximum detected concentrations, the assumption that the chemical was present in its most toxic form (e.g., hexavalent chromium), and the use of frequency of exposures greater than anticipated.

Access to Robins AFB is restricted. Only active duty military personnel and their families reside on the base, and these personnel would generally be stationed at the base for less than 5 years. Access to Zone 1 is further restricted by a locked gate and fence at the landfill entrance. Adjacent to the wetland areas located to the north, south, and east of Zone 1 the site boundary is not fenced because natural conditions discourage trespassing.

Because access to the site is restricted and groundwater from the site is not used for domestic or agricultural purposes, human health exposure pathways are limited.

Base housing is located south of Zone 1 and the adjacent wetland. Because the organic portions of landfilled materials typically decompose, methane and other VOCs may be released in gaseous form from Zone 1 and migrate offsite. Therefore, a principal potential pathway for human exposure is inhalation of these gases migrating from the site to the offsite base housing.

Trespassing has not been observed on the landfill due to natural and imposed access restrictions; however, personnel have been observed fishing in ponds east of the site at the runway approach along Lights Service Road and Hannah Road. No one has been observed in the wetland or shallow standing water in this area. Although trespassing is not expected to be prevalent, potential exposures to contaminated surface soil, sediments, and surface water were evaluated to conservatively estimate human risk.

6.2 RISK ASSESSMENT METHODS/TOXICITY ASSESSMENT

Cancer potency factors (CPFs) for chemicals detected in Zone 1 are presented in Table 4. CPFs have been developed by EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. CPFs, which are expressed in units of $(\text{mg/kg-day})^{-1}$, are multiplied by the estimated intake of the potential carcinogen, in mg/kg-day , to

Table 4
Carcinogenic Classification and Potency Factors for
Chemicals Detected at Zone 1

Chemical	Ingestion Route				Inhalation Route			
	U.S. EPA(b) Carcinogen Class	Carcinogenic Potency Factor (kg-day/mg)	Source (a)	Date	U.S. EPA(b) Carcinogen Class	Carcinogenic Potency Factor (kg-day/mg)	Source (a)	Date
Aldrin	B2	17	IRIS	1-1-91	B2	17	HEAST	10-1-90
Arsenic	A	1.75	HEAST	4-1-89	A	50	IRIS	12-1-88
PCBs	B2	7.7	IRIS	1-1-90	B2	-	IRIS	1-1-90
Benzene	A	0.029	IRIS	1-1-91	A	0.029	HEAST	10-1-90
Benzo[a]anthracene	B2	11.53	c	-	B2	6.11	c	-
Benzo[b]fluoranthene	B2	11.53	c	-	B2	6.11	c	-
Benzo[k]fluoranthene	B2	11.53	c	-	B2	6.11	c	-
Benzo[a]pyrene	B2	11.53	EPA 1980	-	B2	6.11	EPA 1984	-
Benzo[g,h,i]perylene	B2	11.53	c	-	B2	6.11	c	-
Beryllium	B2	4.3	IRIS	1-1-91	B2	8.4	HEAST	10-1-90
bis(2-Ethylhexyl)phthalate	B2	0.014	IRIS	5-1-90	B2	-	IRIS	5-1-90
Bromodichloromethane	B2	0.13	IRIS	10-1-90	B2	-	IRIS	10-1-90
Butyl benzyl phthalate	C	-	IRIS	9-1-89	-	-	-	-
Cadmium	-	-	-	-	B1	6.1	IRIS	6-1-90
Carbon tetrachloride	B2	0.13	IRIS	1-1-91	B2	0.13	HEAST	10-1-90
Chlordane	B2	1.3	IRIS	8-1-90	B2	1.3	IRIS	8-1-90
Chloroform	B2	0.0061	IRIS	1-1-91	B2	0.081	HEAST	10-1-90
Chromium VI	-	-	-	-	A	41	IRIS	6-1-90
Chrysene	B2	11.53	c	-	B2	6.11	c	-
DDD	B2	0.24	IRIS	8-1-89	B2	-	IRIS	8-1-89
DDE	B2	0.34	IRIS	8-1-89	B2	-	IRIS	8-1-89
DDT	B2	0.34	IRIS	1-1-91	B2	0.34	HEAST	10-1-90
Dibenz[a,h]anthracene	B2	11.53	c	-	B2	6.11	c	-
1,4-Dichlorobenzene	B2	0.024	HEAST	10-1-90	B2	-	HEAST	10-1-90
1,1-Dichloroethane	C	-	IRIS	10-1-90	C	-	-	10-1-90
1,2-Dichloroethane	B2	0.091	IRIS	1-1-91	B2	0.091	HEAST	10-1-90
1,1-Dichloroethene	C	0.6	IRIS	3-1-90	C	1.2	HEAST	10-1-90
Dieldrin	B2	16	IRIS	1-1-91	B2	16	HEAST	10-1-90
Indeno[1,2,3-cd]pyrene	B2	11.53	c	-	B2	6.11	c	-
Tetrachloroethene	B2	0.051	HEAST	10-1-90	B2	0.0033	HEAST	10-1-90
1,1,2-Trichloroethane	C	0.057	IRIS	1-1-91	C	0.057	HEAST	10-1-90
Trichloroethene	B2	0.011	HEAST	10-1-90	B2	0.017	HEAST	10-1-90
Vinyl chloride	A	2.3	HEAST	4-1-89	A	0.295	HEAST	4-1-89

a. Sources of Toxicity Values:

IRIS - Integrated Risk Information System U.S. EPA

HEAST - Health Effects Assessment Summary Tables - Quarterly Summary USEPA

EPA 1980 - Ambient Water Quality Criteria for PAHs risk estimates

EPA 1984 - Health Effects Assessment for PAHs (PB86-134244), September 1984

EPA 1987 - USEPA Health Advisory, NTIS, No. PB87245578, March 1987

EPA 1988 - PHRED, July 1988, Update of SPHEM Risk Characterization Tables

b. U.S. EPA Carcinogen Classification

A: Human Carcinogen

B1: Probable Human Carcinogen, limited human evidence

B2: Probable Human Carcinogen, sufficient evidence in animals
inadequate or no evidence in humans

C: Possible Human Carcinogen

c. Based on Benzo[a]pyrene.

provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the CPF. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Cancer potency factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied.

Excess lifetime cancer risks are determined by multiplying the intake level with the cancer potency factor. These risks are probabilities that are generally expressed in scientific notation (e.g., 1×10^{-6} or $1\text{E-}6$). An excess lifetime cancer risk of 1×10^{-6} indicates that, as plausible upper bound, an individual has a one in one million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at a site.

Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg-day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur.

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ) (or the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant's reference dose). The Hazard Index (HI) is the sum of the HQs for all contaminants within a medium or across all media to which a given population may reasonably be exposed. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or several media.

6.3 RISK CHARACTERIZATION

Potential residential and trespasser exposure scenarios were evaluated, and the risk summaries for inhalation are shown in Table 5. The results for inhalation suggest an excess lifetime cancer risk of 3×10^{-6} (3 in 1 million) for residential exposures. This value is calculated for exposure to resuspended (airborne) material and is based on modeling and use of maximum concentrations measured in a single sample. Because the site has a vegetative cover and little or no traffic, the generation of dust is limited. The risk from inhalation of resuspended material based on the average concentrations in surface soils is 1×10^{-7} . Residential risk due to inhalation of VOCs is calculated at 2×10^{-6} . However, the risk from inhalation of VOCs is not site-related because upwind concentrations were similar to downwind. In the evaluations conducted as part of this risk assessment, each hazard index calculated for inhalation exposures was less than 1.

Trespassing onsite, in the wetland, or in standing water was evaluated for incidental ingestion and dermal absorption of surface soil, sediments, or surface water. The risk

Table 5
Summary of Ambient Air Inhalation
Risks by Media and Exposure Setting
Robins AFB

Source	Assumed Receptor	Maximum Excess Lifetime Cancer Risk	Maximum Hazard Index	Major Contaminants
Volatized Contaminants in Ambient Air	Inhalation by child trespasser	1×10^{-6}	0.41	Chloroform, benzene
Volatized Contaminants from Landfill Gas	Inhalation by child trespasser	4×10^{-8}	0.005	Chloroform, vinyl chloride, benzene
Resuspended Material in Ambient Air	Inhalation by child trespasser	2×10^{-6}	0.047	Chromium, cadmium, arsenic
Volatized Contaminants	Inhalation by offsite adult residents	2×10^{-6}	0.066	Chloroform, benzene
Volatized Contaminants from Landfill Gas	Inhalation by offsite adult residents	7×10^{-8}	0.001	Chloroform, vinyl chloride, benzene
Resuspended Material	Inhalation by offsite adult residents	3×10^{-6}	0.008	Chromium, cadmium, arsenic

summaries are shown in Table 6. The excess lifetime cancer risk exceeded 1×10^{-6} only for sediment ingestion (9×10^{-6}), and sediment dermal absorption (3×10^{-5}). There were two primary contributors to this calculated cancer risk: polynuclear aromatic hydrocarbons (PAHs) and arsenic. The high molecular weight PAH compounds seen in the sediments do not appear to have resulted from Zone 1 because these compounds were not seen in the Zone 1 groundwater or surface soil analyses. However, Zone 1 appears to be the source of arsenic contamination because highest arsenic concentrations were seen in the sediments and groundwater near the landfill.

The hazard indexes exceeded 1 for maximum sediment and surface-water values. These samples were collected near the Lights Service Road, where trespassing may occur. The hazard indexes for the average concentrations were less than 1.

Risk calculations for consumption of fish are shown in the RA (Robins AFB, 1990). Arsenic was the only parameter which had a surface-water concentration that exceeded the Federal Ambient Water Quality Criteria (FAWQC) for protection of human health from the consumption of fish. Arsenic and dieldrin exceeded EPA fish tissue concentrations for 10^{-6} risk levels assuming 6.5 gm/day consumption. Assuming fish from this location were eaten 12 times/year for 10 years, the excess lifetime cancer risk is estimated at 4×10^{-6} .

Risks from potable use of the shallow groundwater were not estimated. However, drinking water standards for several parameters have been exceeded in groundwater samples collected in the surficial and quaternary alluvial aquifer in the vicinity of Zone 1. This shallow groundwater is not currently used for water supply, and discharges into the wetland. The groundwater, particularly in the vicinity of the sludge lagoon, exceeds the water quality criteria for protection of aquatic life, suggesting the discharge of these waters to the adjacent surface waters may contribute to exceedances of acceptable levels at that location.

The assumptions used in the risk assessment regarding exposure of a child trespasser are considered conservative. Such exposures would not be likely to increase if access to the landfill were not restricted, since the assumption of 2 days per week at the landfill during the summer months for 10 years may be considered a reasonable recreational exposure scenario.

Potential exposure pathways for a child at the landfill may include inhalation, dermal absorption via soil, and incidental ingestion. In the wetland, the exposure pathways include dermal absorption and incidental ingestion of surface water or sediment. The risks from these two areas are not additive, since the assumption that a child would spend 4 days per week during the summer months in these two areas of the base is extremely conservative.

The summation of risks is a total of the risks for various media from both Zone 1 and ambient sources.

Table 6
Summary of Surface Soil, Sediment, Fish, and Water Ingestion
and Dermal Absorption Risks by Media and Exposure Setting
Zone 1—Robins AFB

Source	Assumed Receptor	Maximum Calculated Excess Lifetime Cancer Risk	Maximum Hazard Index	Major Contaminants
Surface Soil	Ingestion by child trespasser	2×10^{-7}	0.5	Benzo[b]fluoranthene chlordane
	Dermal absorption by child trespasser	2.5×10^{-7}	0.122	Benzo[b]fluoranthene cadmium, chromium
Sediments	Ingestion by child trespasser	9×10^{-6}	1.1	Arsenic, PAH, lead
	Dermal absorption by child trespasser	3×10^{-5}	0.477	PAH, dieldrin
Surface Water	Ingestion by child trespasser	4×10^{-7}	2.8	Arsenic, lead, cadmium, chromium
	Dermal absorption by child trespasser	1×10^{-8}	0.038	Arsenic, chromium
Fish	Ingestion by Adult	4×10^{-6}	--	Arsenic, dieldrin

PAH: Polynuclear Aromatic Hydrocarbons

Exposure Pathway	Average Excess Lifetime Cancer Risk	Average Hazard Index
Landfill		
Soil—incidental ingestion	3×10^{-8}	0.04
Soil—dermal absorption	2.5×10^{-7}	0.122
Air—resuspended material	7×10^{-8}	0.012
Air—ambient air	1×10^{-6}	0.41
Sum of risks	1.35×10^{-6}	0.584
Wetland		
Surface water		
- incidental ingestion	9×10^{-8}	0.16
- dermal absorption	1×10^{-8}	0.0037
Sediment		
- incidental ingestion	3×10^{-6}	0.16
- dermal absorption	1.2×10^{-5}	0.477
Sum of risks	1.51×10^{-5}	0.80

6.4 ECOLOGICAL EVALUATION

Zone 1 and the surrounding area consist of field and planted pine habitats on the landfill and to the east, grading into a permanently inundated wetland forest at Hannah Road and into flood plain bottomland hardwood farther to the east in the Horse Creek area.

The ditch and standing water near the Lights Service Road and Hannah Road provide a more open water habitat than the hardwood wetland. However, the Lights Service Road area has been, and is likely to continue to be, affected by various human activities. The open water habitat results from the impoundment of water by the roads, and most of the water in this area is from the wastewater treatment plant. Trees have been cleared to provide better visibility for aircraft, and the water level is periodically lowered to discourage the establishment of wading bird populations. Metal concentrations found in the area may have resulted from a number of sources and from current and past waste management practices. Concentrations of cadmium, chromium, copper, cyanide, iron, lead, mercury, silver, and zinc in water samples from this area exceeded FAWQC for protection of aquatic life. These elevated concentrations may be due to the presence of particulates in samples preserved prior to filtration. Currently, the Zone 1 monitoring wells are being resampled and metals concentrations re-analyzed on filtered and unfiltered samples.

Field observations suggest that the various ecological stresses in the area of the Lights Service Road appear to be a result of either flooding or human activities unrelated to waste management, such as tree cutting. Vegetative stresses that can be attributed to contaminant release from Zone 1 were not observed in the hardwood forest onsite or in the adjacent wetland.

6.5 CONCLUSIONS

Based on the results of this risk assessment, Zone 1 does not appear to present an unacceptable current public health risk via the inhalation exposure route. There is a potential for environmental risk, and possibly human health impacts, from exposure to metals in surface water, sediment, or fish tissues in which the metals may have bioaccumulated.

Landfill No. 4 and the Sludge Lagoon are contributing to the degradation of the site groundwater. The alluvial aquifer is an unconfined aquifer system that discharges to the wetlands bordering the Ocmulgee River. Site groundwater data indicate that standards and criteria for the protection of human health and aquatic life are being exceeded in the site groundwater. A further assessment of risks to human health and the environment resulting from Zone 1 groundwater contamination will be addressed in Operable Units 2 and 3.

In summary, actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present a current or potential threat to public health, welfare, or the environment.

7.0 DESCRIPTION OF ALTERNATIVES

The alternatives developed in the FS and presented below represent conceptual approaches to site remediation. Specific details of alternatives were developed to allow order-of-magnitude cost estimations. The selected remedy incorporates the concepts of the FS alternatives selected. Details are defined during the design process where further field investigations and/or bench and pilot scale testing may be performed.

7.1 LANDFILL NO. 4

7.1.1 Alternative 1—No Action

Consideration of a no-action alternative is required by the NCP. Under Alternative 1, no response actions would be implemented.

7.1.2 Alternative 1A—Limited Action

The limited action alternative consists of institutional controls for future site access, groundwater use restrictions, and long-term groundwater monitoring. Waste will remain in place and contamination will not be addressed. Costs are associated with fence construction and the placement of warning signs around the perimeter and the installation of monitoring wells.

7.1.3 Alternative 2—Cover Renovation and Lagoon Groundwater Source Control

Under Alternative 2, landfill infiltration would be reduced and groundwater from the Quaternary and upper Providence aquifers below and immediately downgradient of the Sludge Lagoon would be extracted. Surface water run-on would be intercepted and diverted around Landfill No. 4. The landfill cover would be renovated by clearing the landfill surface, regrading the site to maintain a minimum 2-foot cover over the waste materials, and sloping the surface to promote runoff and limit the effects of differential settlement. The site would be seeded to promote evapotranspiration of precipitation and to prevent surface erosion.

Two groundwater extraction wells near the perimeter of the Sludge Lagoon screened in the Quaternary and upper Providence aquifers would intercept the more highly contaminated groundwater being released in Zone 1. Based on pump test results, a combined pumping rate of 110 gpm is expected to capture the lagoon groundwater plume. Groundwater extracted from the lagoon area would be treated at the base to National Pollution Discharge Elimination System (NPDES) limits.

7.1.4 Alternative 3—Multilayer Cap and Leachate and Lagoon Groundwater Source Control

Under Alternative 3, landfill infiltration would be greatly reduced, landfill leachate would be collected, and groundwater from the Quaternary and upper Providence aquifers below and immediately downgradient of the Sludge Lagoon would be extracted in the same manner as in Alternative 2. The existing landfill cover would be replaced with a new cap incorporating a flexible membrane liner (FML) as the

impervious barrier. The cap is expected to meet objectives for the landfill by greatly reducing run-on and infiltration and the resulting contaminant migration. Landfill gas would be collected and released to the atmosphere after treatment to meet Applicable or Relevant and Appropriate Requirements (ARARs).

Under Alternative 3, leachate would be extracted from the landfill area. The conceptual leachate collection system would consist of a series of trenches and perforated collection pipes manifolded into a central collection line and pump station. Leachate would be treated at the base to NPDES limits. The leachate collection system would meet Operable Unit 1 goals by essentially eliminating leaching of hazardous substances to the Quaternary and Providence aquifers.

7.2 SLUDGE LAGOON

7.2.1 Alternative 1—No Action

Consideration of a no-action alternative is required by the NCP. Alternative 1 for Robins AFB does not include any response actions.

7.2.2 Alternative 1A—Limited Action

The Limited Action alternative provides for institutional controls for restriction to the area and future land use. No remedial actions to upgrade the Sludge Lagoon cover or to provide treatment would be taken.

7.2.3 Alternative 2—In Situ Soil Vapor Extraction and In Situ Solidification

Alternative 2 would address the hazardous substances in the Sludge Lagoon by means of in situ treatment methods. It is intended to provide treatment of hazardous substances without excavation. This general approach addresses the CERCLA preference for treatment while avoiding excavation and consequent risks from release of VOCs. The RCRA land disposal restriction requirements, which are considered to be ARARs, would not affect implementability of Alternative 2.

Costs were developed in the FS for the following treatment system. Under Alternative 2, steam would be injected into the ground, and then the steam containing the VOCs would be removed by a "vacuum" system in the soil. Volatile contaminants would be removed from the air by condensation, distillation, and adsorption on activated carbon. After most of the organic compounds have been removed, the soil containing the non-volatile compounds, such as metals, would be solidified in place. Long-term testing would be performed to verify the effectiveness of treatment. An estimated 15,000 cubic yards of soil would be treated. It is estimated that 75 to 90 percent of the VOCs would be removed during the in situ soil vapor extraction (ISVE) process, greatly reducing the risk of releases.

The practical implementability of Alternative 2 is influenced by the high groundwater table at the lagoon and the physical properties of the peat. Bench scale and pilot testing would be required during predesign to confirm system performance, practicality and develop performance criteria.

7.2.4 Alternative 3—Excavation, Low-Temperature Volatilization, Solidification, and Onsite RCRA Landfill

Under Alternative 3, hazardous substances in the Sludge Lagoon would be excavated, treated by low-temperature volatilization (LTV), solidified, and placed in a RCRA landfill on Robins AFB property.

In the LTV process an estimated 15,000 cubic yards of contaminated soil would be agitated and heated to 500° to 800°F, which would volatilize many of the organic contaminants from the soil. LTV has been shown in both bench- and pilot-scale tests to remove more than 99 percent of chlorinated VOCs from soil. Offgases would be passed through an afterburner to oxidize the volatilized organic compounds to carbon dioxide and water. The offgases would also pass through pollution control devices for particulate and acid gas removal as needed to meet ARARs before discharge to the atmosphere.

The residual material discharged from the volatilization unit would be solidified to immobilize metals and unvolatilized organic compounds. It is likely that solidification to meet the RCRA land disposal restrictions would be necessary. Solidification is an assumed requirement only for the purpose of estimating the cost for this alternative.

A RCRA cell with a design capacity of 25,000 cubic yards would be constructed to contain the treatment residue. The RCRA cell would be designed to satisfy the EPA's minimum technology guidance requirements for hazardous waste management facilities. The conceptual design of the RCRA cell would probably consist of a double liner system with primary and secondary leachate detection, collection, and removal systems and a double layer cap system with a drainage layer and topsoil-fill cover layer.

Alternative 3 is intended to minimize treatment costs while meeting RCRA Land Disposal Restrictions (LDRs) applicable to F001 and F006 wastes before placement in a RCRA landfill at Robins AFB. This general approach addresses the CERCLA preference for use of treatment to reduce the toxicity, mobility, or volume of hazardous substances.

7.2.5 Alternative 4—Excavation, Incineration, Solidification, and Replacement Onsite

Under Alternative 4, hazardous substances in the Sludge Lagoon would be managed by excavation followed by treatment sufficient to replace the materials onsite. Incineration of the estimated 15,000 cubic yards of soil would be performed using a portable unit operated near the Sludge Lagoon. Incineration is expected to remove more than 99.9 percent of all organic hazardous substances in the soil. The residual soils would be solidified to immobilize metals, delisted as a hazardous waste, and replaced at Zone 1.

Alternative 4 is intended to provide a treatment approach that would generate a residue suitable for replacement onsite. This general approach addresses the CERCLA preference for use of treatment to reduce the toxicity, mobility, or volume of hazardous substances while complying with the ARARs of the RCRA land disposal restrictions on handling both F001 solvent wastes and F006 electroplating wastes.

8.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

8.1 LANDFILL NO. 4

8.1.1 Overall Protection of Human Health and the Environment

Based on the RA, it is believed that site contamination is not posing risks to human health due to the lack of exposure. However, it is possible that contaminants are migrating to wetlands at levels that pose risks to environmental receptors near the Sludge Lagoon. Under Alternative 1, these conditions would remain unchanged. It is reasonable to expect that some ecological/environmental benefits are achieved by controlling the source of contamination from Zone 1 in Operable Unit 1.

Alternatives 2 and 3 will achieve source control and attain the remedial action objectives for protection of public health and the environment. Protection of the environment and the ecology in the surrounding wetlands from releases is provided by Alternatives 2 and 3 through Landfill No. 4 and Sludge Lagoon source control and Sludge Lagoon groundwater collection and treatment.

Alternative 3 will provide additional protection to public health and the environment through two remedial technologies—the multilayer cap and leachate collection. Reliance on monitoring, although still important, is not as great under Alternative 2.

8.1.2 Compliance with ARARs

Alternatives 1 or 1A will not comply with action-specific ARARs because the Sludge Lagoon and the landfill will have a cover less permeable than the clay-peat below them. Alternatives 1 or 1A will not comply with the chemical-specific ARARs because hazardous substances will continue to be released from the Sludge Lagoon and the landfill.

Renovation of the Landfill No. 4 cover is proposed for Alternative 2. This action may not produce a cover that is less permeable than the layer below the landfill. Alternative 2 includes a Sludge Lagoon groundwater collection system that would control releases of hazardous substances. The collected water would be treated at Robins AFB. Robins AFB would comply with the conditions of the applicable permits during the treatment of the contaminated groundwater. Monitoring would be required to protect the nearby wetlands.

The soil-FML cap proposed for Alternative 3 will comply with the RCRA cover ARAR requirement for covers to be less permeable than the bottom liner system or natural subsoils. Alternative 3 includes a Sludge Lagoon groundwater recovery system. The collected water will be treated at Robins AFB. Alternative 3 also includes collection of contaminated leachate in the landfill and treatment at Robins AFB. Robins AFB will comply with the conditions of applicable permits during the treatment of the contaminated groundwater.

8.1.3 Long-term Effectiveness and Permanence

Alternative 2 would reduce infiltration through the landfill by an estimated 10 percent.

Alternative 3 consists of a leachate collection system for Landfill No. 4 and a soil Flexible Membrane Liner (FML) cap that would reduce infiltration by an estimated 80 percent. This configuration of technologies will provide an increase in the overall reliability of the landfill remediation.

8.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternatives 1 or 1A would reduce the amount of contaminants through natural attenuation, but the magnitude of the reduction is unknown.

Leachate and groundwater would be treated in Alternatives 2 and 3. The treatment would remove 80 to 99 percent of the organic concentrations and between 80 to 90 percent of the metals concentrations.

8.1.5 Short-Term Effectiveness

Short-term construction effects related to dust and noise generation are expected for all alternatives except Alternatives 1 or 1A. Release of VOCs during the excavation of the leachate collection system is a concern for Alternative 3. Workers would be at risk from inhalation or dermal absorption of hazardous substances during excavation.

Alternative 2 will reduce the contaminants leaching to the groundwater. It is estimated that the Sludge Lagoon groundwater collection system would operate for 5 years to remove the majority of the contaminants in the area of the Sludge Lagoon groundwater collection.

The time periods estimated for implementing the alternatives as described in the summary of alternatives are 6 months for Alternative 2 and 18 months for Alternative 3.

8.1.6 Implementability

Each alternative is believed to be technically feasible to construct and operate. Cap renovation and groundwater collection technologies are technically and administratively feasible. Commercial services and materials are readily available.

The soil-FML cap and the leachate collection systems of Alternative 3 may pose some problems. The soil-FML cap requires special contractors and careful quality control during installation. Because of the potential for damaging the FML during uncovering for post-installation inspection, maintenance will be limited only to areas of substantial subsidence.

Construction of the leachate collection system in the landfill may pose some problems because of the heterogeneous nature of the solid waste. However, excavators that lay pipe and backfill without the need of an open trench are available from specialty contractors.

8.1.7 Cost

The cost for Alternative 2 is estimated to be significantly less than Alternative 3 for Landfill No. 4. (Table 7).

Table 7 Landfill No. 4 Alternatives				
	1 No Action	1A Limited Action	2 Cover Renovation, Sludge Lagoon Groundwater Source Control	3 Multilayer Cap. Leachate and Sludge Lagoon Groundwater Collection
Estimated Capital Costs	\$0	\$385,000	\$2,380,000	\$10,800,000
Estimated Annual O&M Costs	0	36,000	220,000	230,000
Estimated Present-Worth Costs	0	756,000	3,630,000	12,200,000

8.1.8 Agency Acceptance

The U.S. EPA and GEPD have rejected Alternatives 1 and 1A since they are not sufficiently protective of public health and the environment. Alternative 2 has also been rejected since it does not comply with the RCRA ARAR requirement for a landfill cover of lower permeability than the underlying layer.

8.1.9 Community Acceptance

Two comments regarding the Landfill No. 4 selected remedy were received. One was in favor of the selected remedy and the other questioned the cost effectiveness of placing a low permeability cover over the landfill since the leachate collection system would capture infiltrating water anyway. Robins AFB believes reduction of infiltration is an important aspect of the selected remedy since the waste will remain onsite and contaminant leaching could continue far into the future.

Judging by the comments received, it is believed that the community is supportive of the Landfill No. 4 selected remedy.

8.2 SLUDGE LAGOON

8.2.1 Overall Protection of Human Health and the Environment

The overall protection of public health and the environment for the Sludge Lagoon is related to the reduction of mass and migration of hazardous substances and reduced potential for direct contact with hazardous substances.

Based on the ecological assessment, the risk to the environment will be reduced or eliminated by implementation of a final remedy, which includes a ROD for all operable units. It is reasonable to expect that some ecological/environmental benefits are achieved by controlling the source of contamination from Zone 1 in Operable Unit 1.

Alternative 1 provides no protection. Alternative 2 provides for an estimated 75 to 90 percent removal of VOCs and greatly reduces the risk of releases through solidification of residual contaminants. Alternative 4 offers the advantage of more complete organic contaminant destruction—an estimated 99.99 percent of total organic contaminants versus 90 to 99 percent of volatile organic under Alternative 3. Alternative 3, however, destroys mobile organics contaminants as well as disposes of the treated residuals in an RCRA landfill.

8.2.2 Compliance with ARARs

Alternatives 1 or 1A do not comply with action-specific or chemical-specific ARARs associated with the Sludge Lagoon. Alternative 2 complies with ARARs includes a cap over the Sludge Lagoon to minimize leaching and meet closure requirements. Once Alternative 2 is completed it should be easier to achieve the chemical-specific ARARs in the groundwater. Alternative 4 complies with the ARARs.

Alternative 3 will be conducted in accordance with requirements for RCRA land disposal, since the Sludge Lagoon will be excavated. The LTV is estimated to be able to achieve the land disposal restriction requirements.

Because the treated waste will be placed in a RCRA permitted landfill, management of ash and other residual materials will meet RCRA ARARs.

8.2.3 Long-Term Effectiveness and Permanence

The four alternatives represent a range of technologies for remediation of the Sludge Lagoon wastes, from natural attenuation, in Alternatives 1 and 1A, to incineration with ash solidification in Alternative 4.

Alternative 2 includes ISVE and in situ solidification of remaining contaminants. In situ techniques cannot guarantee complete mixing of the sludge-contaminated soil mass. Long-term monitoring will be required to evaluate the effectiveness of the remedy.

The residual risks from Alternative 3 are expected to be lower than Alternative 2 residual risks because the hazardous substances are excavated, treated, and disposed of in an onsite RCRA landfill. The potential for release of contaminants from a RCRA landfill is considered small, because organic contaminants will have first been reduced by about 90 percent and inorganic contaminants immobilized.

The residual risks from Alternative 4 are expected to be somewhat lower than for Alternative 3 because of the greater destruction efficiency of incineration—about 99.99 percent. The inorganic contaminants will be immobilized through solidification.

8.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternatives 1 or 1A offer no reductions through treatment.

The use of various organic treatment technologies—Alternative 2, ISVE; Alternative 3, LTV; Alternative 4, incineration—would have increasing effectiveness on the reduction of toxicity, mobility, or volume. It is estimated that Alternative 2 would remove 75 to 80 percent of VOCs; Alternative 3 will remove 80 to 99 percent VOCs and a broader range of semivolatile contaminants and Alternative 4 will destroy more than 99.99 percent of the organic hazardous substances.

Alternatives 2, 3, and 4 include solidification intended to render treated contaminants immobile.

8.2.5 Short-Term Effectiveness

Impacts to the Robins AFB community during the remedial action are related to: 1) the potential release of VOCs; 2) onsite dust, noise, and erosion effects generated by construction activities, and 3) truck traffic associated with hauling materials and equipment.

Workers have a greater potential for exposure to hazardous substances for Alternatives 3 and 4 compared to Alternative 2 because the Sludge Lagoon waste is excavated and handled.

The time periods estimated to implement the alternative are 31 months for Alternative 2, 48 months for Alternative 3, and 48 months for Alternative 4.

8.2.6 Implementability

Alternatives 2, 3, and 4 involve technologies that have multiple vendors. These technologies require specialized procedures and equipment, but are commercially available.

8.2.7 Cost

The costs for Alternative 2 is estimated to be significantly less than the costs of Alternative 3 or Alternative 4 for the Sludge Lagoon. (Table 8).

Table 8 Sludge Lagoon Alternatives					
	1 No Action	1A Limited Action	2 ISVE and In Situ Solidification	3 Excavation and LTV Followed by Solidification and Onsite RCRA Landfill Disposal	4 Excavation, Incineration, Solidification and Replacement Onsite
Estimated Capital Costs	\$0	\$0	\$6,200,000	\$14,200,000	\$17,500,000
Estimated Annual O&M Costs	0	0	1,400	5,200	5,200
Estimated Present-Worth Costs	0	0	6,300,000	14,300,000	17,500,000

8.2.8 Agency Acceptance

The U.S. EPA and GEPD have rejected Alternatives 1 and 1A since they are not protective of public health and the environment and do not meet site ARARs.

8.2.9 Community Acceptance

Several comments on the Sludge Lagoon selected remedy were received. Concern was expressed over the potential for leaching of contaminants from the solidified waste and for potential air emissions from the treatment process. The degree of contaminant leaching from the treatment soils will be determined during design treatability testing. The selected remedy would be implemented only if the testing showed remedial goals are achievable. Air emission controls will be used in the selected remedy to control volatile organic contaminant emissions to concentrations below those posing risks to human health.

Given the treatability test and monitoring that will be performed, it is believed that the community is supportive of the selected remedy for the Sludge Lagoon.

9.0 SELECTED REMEDY

Based upon consideration of the requirements of CERCLA, the detailed analysis of the alternatives, and public comments, Robins AFB in consultation with U.S. EPA and GEPA have determined that the most appropriate remedy for Landfill No. 4 is Alternative 2 plus the addition of clay to the cover and a leachate control system, and for the Sludge Lagoon the most appropriate remedy is Alternative 2.

The complete remedy for Operable Unit 1, Source Control includes:

- Surface water run-on diversion
- Landfill No. 4 cover renovation including clearing, filling, regrading, addition of soil and clay cover material, and seeding
- Leachate control for Landfill No. 4 and treatment at Robins AFB
- Sludge Lagoon groundwater collection and treatment at Robins AFB
- Treatment of the Sludge Lagoon to remove VOCs, followed by solidification for the immobilization of metals.
- Environmental monitoring to determine effectiveness of the remedial action

Prior to final design several bench and pilot scale tests will be needed. Pilot scale leachate collection tests are planned and bench and pilot scale treatability testing of the landfill leachate, Sludge Lagoon soils, and groundwater will be performed. The results of these tests will enable adjustments to the final design, recalculation of implementation costs, and determination of performance criteria to meet the conceptual approach and outlined objectives.

The estimated cost of the selected remedy is presented in Table 9.

9.1 REMEDIATION GOALS

The specific objectives of the selected remedy are to:

1. Significantly reduce surface water run-on to Landfill No. 4 and reduce the potential for infiltration and leaching of contaminants from the landfill to the groundwater.
2. Reduce infiltration through increasing run-off of precipitation from the landfill cover and achieving a landfill cover permeability less than the underlying soils.
3. Reduce the groundwater mound in the landfill to reduce groundwater contact with contaminants in the fill.

Table 9
Selected Remedy Cost Estimate^a

	Sludge Lagoon Treatment	Landfill No. 4 Cover Renovation with Addition of Clay^b	Leachate Collection Lagoon GW Collection and Treatment
Estimated Capital Cost	\$6,200,000	\$4,000,000-13,000,000	\$2,500,000
Estimated Annual O&M Cost	1,400	43,000-30,000	290,000
Estimated Present Worth Cost	\$6,300,000	4,400,000-13,300,000	4,400,000

^a Order-of-magnitude cost estimates based on FS assumptions for remedial components

^b Cost range based on varying assumptions on:

- Clay thickness (1' vs. 2')
- Clay source (local clayey sand vs. bentonite plus local clay)
- Cover slope (1% vs. 3%)

4. Treat Sludge Lagoon contaminants that could cause exceedance of groundwater and surface water goals based on information obtained from Toxicity Characteristics Leaching Procedure (TCLP) extraction tests.
5. Collect and treat contaminated groundwater in the Quaternary and Providence aquifers from below and immediately downgradient of the lagoon that has a potential to adversely impact wetlands and surface water receptors.
6. Formally establish institutional controls to eliminate potential exposures to hazardous substances through property restrictions.

Contaminant specific remedial goals have not yet been established for the treatment of soils at the Sludge Lagoon since they are dependent on establishment of groundwater goals (to be developed in Operable Unit 3) protective of groundwater and surface water receptors. The Zone 1 groundwater operable unit RI/FS currently underway will develop goals for groundwater based on potential receptor locations and fate and transport analysis. It is anticipated that the Sludge Lagoon remedial goals will be based on meeting the groundwater goals in a TCLP extract.

10.0 STATUTORY DETERMINATIONS

Under its legal authorities, the EPA's primary responsibility at Superfund sites is to undertake remedial actions that achieve adequate protection of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences. These specify that when complete, the selected remedial action for this site must comply with applicable or relevant and appropriate environmental standards established under Federal and State environmental laws unless a statutory waiver is justified. The selected remedy also must be cost-effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the statute includes a preference for remedies that employ treatments that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as their principal element. The following sections discuss how the selected remedy meets these statutory requirements.

10.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedy protects human health and the environment through capping of Landfill No. 4, collection of landfill leachate, treatment of VOC contaminated soil in the Sludge Lagoon, solidification of the Sludge Lagoon soil and collection and treatment of groundwater adjacent to the Sludge Lagoon.

The landfill cover and treatment of the Sludge Lagoon are expected to reduce the site related risks from inhalation of dust and VOCs and ingestion of soil to below the range of acceptable exposure levels (10^{-4} to 10^{-6}). In addition, contributions of contaminants to the groundwater will be significantly reduced by the selected remedy. Remediation of groundwater will be addressed in Operable Unit 3. Short-term risks occurring during construction will be controlled through a stringent health and safety program. No adverse cross media impacts are expected.

10.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The selected remedy will comply with all ARARs. The following were identified as ARARs for Operable Unit 1:

- RCRA requirements for landfill closure in 40 CFR 264.111 Subpart G, which specifies a cap with a permeability less than or equal to the permeability of any bottom liner or natural subsoils present at the site.
- RCRA disposal requirements, 40 CFR 264, and land disposal restrictions, 40 CFR 268, are ARARs for excavated soil.
- Clean Water Act requirements for direct discharge of treatment system effluent (40 CFR 122). Treatment of landfill leachate and groundwater from the Sludge Lagoon collection system will meet NPDES discharge limits.

- Georgia Air Quality Act requirements for treatment of air emissions from removal of VOCs from the sludge lagoon soil.
- Requirements to avoid adverse effects from construction in a 100-year flood plain under Executive Order 11988, 40 CFR 6 and 40 CFR 264.18(b)
- Requirements to minimize destruction, loss or degradation of wetlands under Executive Order 11990 and 40 CFR 6.
- Endangered Species Act. The existence of endangered or threatened species will be investigated in Operable Unit 2.

10.3 COST-EFFECTIVENESS

The selected remedy for Landfill No. 4 has been determined to provide overall effectiveness proportional to its costs. The selected remedy is protective of public health and the environment and is less expensive than Alternative 3. The selected remedy for the Sludge Lagoon has also been determined to be protective of public health and the environment and is substantially less expensive than low temperature thermal volatilization or incineration.

10.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES (OR RESOURCE RECOVERY TECHNOLOGIES) TO THE MAXIMUM EXTENT PRACTICABLE

It has been determined that the selected remedy for operable Unit 1 represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for Landfill No. 4 and Sludge Lagoon source control operable unit. Treatment of the Landfill No. 4 contents was found to be impractical because of the large size of the landfill (45 acres).

Of the alternatives that are protective of human health and the environment and comply with ARARs, Robins AFB has determined that the selected remedy provides the best balance of tradeoffs in terms of long-term effectiveness and permanence, reduction in toxicity, mobility or volume achieved through treatment, short-term effectiveness, implementability, cost, while also considering the statutory preference for treatment as a principle element and considering state and community acceptance.

While the Landfill No. 4 Alternative 3 offers the greatest long-term effectiveness and permanence because it includes both a low permeability cap and a leachate collection system, it was concluded that the extra costs of this redundancy were not justified in view of the overall risks from the site. The selected remedy for Landfill No. 4 reduces the potential for infiltration and collects infiltration via the leachate collection system. The selected remedy for Landfill No. 4 offers the same or better reduction in toxicity, mobility, or volume through treatment than that provided by the three FS alternatives through collection and treatment of the landfill leachate and contaminated lagoon groundwater. While short-term construction risks to workers are expected during installation of the leachate collection system, it is believed that this risk is outweighed by the need to install the leachate system for the protection of public health and the environment.

The selected remedy for the Sludge Lagoon does not offer as high a degree of long-term effectiveness and permanence as the LTV or incineration alternative. However, it is expected to significantly reduce the risks associated with the Sludge Lagoon through removal of the VOCs and solidification of the metals. Treatability testing will be conducted to verify the ability of vapor extraction and solidification to reduce the amount of contaminant leaching to concentrations below those causing unacceptable risks. The greater costs associated with LTV and incineration are not considered to be justifiable in view of the expected effectiveness of the selected remedy. The selected remedy uses treatment to reduce the VOC content in the Sludge Lagoon by an estimated 75 to 80 percent. While LTV and incineration will remove greater amounts, solidification of the residuals is expected to reduce mobility to below concentrations posing risks. Short-term construction related effects on the community and workers would be the least under the selected remedy if in situ treatment is viable, otherwise effects are generally similar between alternatives.

The selected remedy for Landfill No. 4 and the Sludge Lagoon is consistent with program objectives that indicate highly toxic or mobile wastes are a priority for treatment. Treatment of the less concentrated wastes of Landfill No. 4 was found to be impracticable. In general, the differences in long-term effectiveness and reductions in toxicity, mobility, or volume between the protective alternatives were judged to be relatively minor in view of the potential risks. The selected remedy is the least expensive of the alternatives that are protective of human health and the environment and that meet ARARs. In addition, the selected remedy for the Sludge Lagoon may be performed in situ, thus reducing potential short-term risks to workers and residents.

10.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

Treatment of the Sludge Lagoon is a principal element of the selected remedy. Because the Sludge Lagoon contains the most concentrated area of contaminants it represents one of the principal threats of Zone 1. Therefore, the statutory preference for remedies that employ treatment as a principal element is satisfied.

10.6 DOCUMENTATION OF SIGNIFICANT CHANGES

No significant changes from the proposed plan were made.

COMMUNITY RELATIONS RESPONSIVENESS SUMMARY

COMMUNITY RELATIONS RESPONSIVENESS SUMMARY

1.0 OVERVIEW

Robins AFB along with U.S. EPA and GEPC held a public meeting on May 8, 1991, at the Warner Robins City Hall to discuss the results of the RI/FS, present the proposed plan and solicit comments and questions from the public. The majority of questions and comments received during the public comment period were received during the public meeting. In general the comments were supportive of the Proposed Plan for Landfill No. 4 and the Sludge Lagoon.

2.0 BACKGROUND ON COMMUNITY INVOLVEMENT

An active community relations program providing information and soliciting input has been conducted by Robins AFB for Zone 1. Interviews of citizens on base and in Warner Robins were conducted in the summer of 1990 to identify community concerns. No significant concerns that required focused response were identified. Regular informational project updates have been provided to the public through television programs, the Robins AFB newspaper, *The Rev-Up*, the *Warner Robins Daily Sun*, and the *Macon Telegraph*. *Robins Report*, a weekly 15-minute television program produced by the Office of Public Affairs has provided routine progress updates. This program is aired Sunday mornings on WMAZ-TV in Macon, Georgia. It also is telecast on Cox Cable and Watson Communications Cable, which are available to Robins AFB and Warner Robins. Weekly informational articles have appeared in *The Rev-Up* newspaper. In addition, NPL site and IRP fact sheets have been prepared and made available in the Environmental Information Repository, located in the Nola Brantley Memorial Library in Warner Robins.

3.0 SUMMARY OF PUBLIC COMMENT AND AGENCY RESPONSE

Comments and questions raised during the public meeting held on May 8, 1991, and those received during the public comment period are summarized below.

1. One resident asked when was disposal at the landfill stopped. An ex-employee stated that he believed dumping in the area continued at least until 1988.

Robins AFB Response: Landfill No. 4 and Sludge Lagoon were closed in 1978. After that time sludges from the Industrial Wastewater Treatment Plant (IWTP) and Sewage Treatment Plant (STP) have been dumped in a nearby area outside Zone 1. The state of Georgia has been notified and this area is listed in the base Installation Restoration Program (IRP) and is being evaluated.

2. One resident asked how the landfill investigation was performed and where are the records of the investigations.

Robins AFB Response: Samples were taken of the soil and materials in the Sludge Lagoon and Landfill No. 4 and analyzed for a comprehensive list of contaminants. Results are available in the Remedial Investigation Report located in the Environmental Information Repository.

3. Two residents questioned whether local drinking water wells would be monitored.

Robins AFB Response: Offbase, the City of Warner Robins performs routine monitoring of its drinking water. Robins AFB tests its water supply routinely and analyzes for a full range of contaminants. Wells west of Highway 247 cannot be contaminated as a result of Robins AFB because groundwater flow on the base is to the east, directly away from Highway 247.

4. One resident commented that no one from the local community or employee representative of the base was on the panel at the public meeting.

Robins AFB Response: While the comment is true for the panel presenting and answering questions at the public meeting, the community relations process did include interviews with community residents to solicit input on community concerns.

5. The Houston County Board of Health commended Robins AFB on its openness, responsiveness, and its desire to accelerate the cleanup program. A resident also commended the base for serving as a leader in the environmental world.

Robins AFB Response: Robins AFB has had an active community relations program and will continue the program through remediation. The commendations are appreciated.

6. Citizens for Responsible Environmental Planning commented that the reason for lack of public participation may be due to the fact that Robins AFB is the largest employer in the area and that Robins AFB has downplayed the significance of the health risk.

Robins AFB Response: Robins AFB believes community involvement in the remedy selection process was good. The base has not misrepresented the risks to public health, but rather has tried to accurately present the results of the remedial investigations and the risk assessment for Landfill No. 4 and the Sludge Lagoon.

7. A letter from the Ocmulgee Sierra Club stated that citizen participation was limited due to the inability of the base to incorporate public scrutiny and that the base holds a power over people who work on the base.

Robins AFB Response: Robins AFB believes community relations in the remedy selection process was good. A community relations plan was written in March 1990 and was used during the process. Several newspaper articles and news stations presented information about the site, the remedial alternatives, and risks associated to health and the environment. The public meeting also provided the community an opportunity to express concerns of the preferred alternative for the remedial action of the source control.

8. Several residents and the Houston County Board of Health expressed concern about the long-term monitoring of the site. In particular, questions were asked about who will perform the monitoring, will it be continued as long as the wastes remain, and will adequate records be maintained.

Robins AFB Response: Robins AFB will continue monitoring the site groundwater and surface water as long as the wastes remain onsite. The frequency of monitoring may diminish in the future if the data indicate that risks are not occurring and are not likely to occur. GEPA and EPA will be kept informed of monitoring results and records documenting the results will be maintained at Robins AFB, GEPA, and in the Environmental Repository. In addition, every 5 years a formal review of the performance of the selected remedy is performed, and if necessary, modifications to the remedy will be made. Also the remedy is reviewed by GEPA when the Robins AFB RCRA permit is renewed.

9. One resident requested a list of example sites where the selected remedy was similar to the one for Zone 1.

Robins AFB Response: A list of sites with descriptions of the remedies will be sent to the resident. Some of the sites using similar solidification techniques are: Kerr-McGee Refining Corp. in Dubach, Louisiana, an oil reprocessing plant in Douglasville, Pennsylvania, the Portable Equipment Salvage Company in Clachamas, Oregon. Soil vapor extraction has been used at numerous sites including the Verona site in Battle Creek, Michigan.

10. A question was asked as to the potential for leaching of contaminants from the solidified waste.

Robins AFB Response: Treatability tests will be performed on the Sludge Lagoon wastes prior to implementation of the remedy. The objective of the tests will be to determine if contaminant leaching occurs and if so, how much leaching occurs. The remedy will not be implemented if the testing shows that leaching at concentrations that could adversely affect groundwater or surface water can occur. One aspect of the remedy, soil vapor extraction, is intended to reduce the potential for leaching by removing the mobile contaminants prior to solidification.

11. A resident commented that he felt the selected remedy for the landfill is a good alternative, but that he was concerned with whether the soil vapor extraction system would work and concerned with the concept of leaving the treated soil in place. His preference for the Sludge Lagoon is disposal in a RCRA landfill.

Robins AFB Response: Treatability testing of the soil vapor extraction system is also planned prior to implementation. As stated above, the remedy will not be implemented if sufficient organics cannot be removed. Disposal of the treated wastes in a RCRA landfill is not considered cost effective because the potential for leaching of the solidified wastes at concentrations posing risks is not considered significant. In addition, construction of a RCRA landfill on base may not be desirable because of the added burden of maintenance and long-term monitoring of the facility.

12. A resident expressed concern over the potential for air pollution from the soil vapor extraction system.

Robins AFB Response: The soil vapor extraction system will include emission controls to remove the volatilized organic contaminants to concentrations below those posing risks to human health.

13. A question was asked as to what role U.S. EPA and GEPD played in the remedy selection process and if the agencies were in agreement with the selected remedy.

Robins AFB Response: Georgia EPD serves as the regulatory agency for Zone 1. U.S. EPA is also a regulatory agency while Robins AFB is the lead agency. U.S. EPA and GEPD were consulted throughout the RI/FS and remedy selection process and modifications to the remedy were made as a result of their input. U.S. EPA and GEPD are in agreement with the proposed plan.

14. A resident expressed concern as to the cost effectiveness of placing a cover over the landfill if the leachate collection system will capture infiltrating water anyway.

Robins AFB Response: The cover renovation will include removing the trees on the landfill and adding clay to the cover. These actions are expected to reduce infiltration reaching the leachate collection system and thus reduce the cost of leachate treatment. Because the waste will remain onsite and contaminant leaching could continue far into the future, Robins AFB believes the reduction of infiltration is an important objective of the selected remedy.

15. Citizens for Responsible Environmental Planning expressed their preference for Sludge Lagoon Alternative 3—Excavation, LTV, Solidification, and Onsite RCRA Landfill. They commented that the proposed plan alternative is not the best available technology, has a high level of uncertainty to its effectiveness and that there is a lack of historic operational data available. In addition, they commented that an onsite RCRA landfill would be useful for remediation of other Robins AFB sites.

Robins AFB Response: As stated in response to comment number 4, treatability testing of the soil extraction system and solidification system is planned to determine the effectiveness of the proposed remedy prior to implementation. If they are not capable of reducing contaminant leaching to concentrations below those causing risks to public health or the environment, they would not be implemented. If this were to occur, Robins AFB would re-evaluate Alternatives 3 and 4 and propose one of the two in another proposed plan. The treatability testing is expected to address the concern over uncertainties in effectiveness and lack of site-specific operational data. Innovative or alternate treatment technologies cannot be ruled out because historic operational performance data is not as great as other technologies.

16. Citizens for Responsible Environmental Planning expressed their preference for Landfill No. 4 Alternative 3—Multilayer Cap and Leachate and Lagoon Groundwater Source Control. They commented that the proposed plan alternative would allow a significant amount of contamination to leach into the groundwater, that it may still not be in compliance with ARARs, that it does not include needed groundwater collection and treatment, and that additional studies of wildlife in the wetland be performed.

Robins AFB Response: The proposed plan includes a leachate control system to intercept infiltrating contaminants and to control groundwater that is in contact with the landfilled waste. It appears that the comments assumed that a leachate control

system was not included in the proposed plan. Reducing infiltration to very low amounts, as in Alternative 3 is not believed to be cost-effective since the objective of the leachate control system is to capture the leaching contaminants.

U.S. EPA GEPA believe that the RCRA requirement for a cap of lower permeability than the underlying soil is an ARAR. The proposed plan cover renovation would be designed to meet this ARAR.

The need for groundwater collection and treatment in addition to the lagoon groundwater collection and treatment system is not part of Operable Unit 1 and will be addressed in the Groundwater Operable Unit 3.

The wetlands Operable Unit 2 is investigating impacts on surface water quality and the biota in the wetlands east of Landfill No. 4. Field work is planned to begin this summer.

17. A letter from the Ocmulgee Sierra Club stated that Sludge Lagoon Alternative 2 was not acceptable because the technology is unproven and inefficient. The club expressed a preference for Sludge Lagoon Alternative 3.

Robins AFB Response: Robins AFB disagrees with this statement. The solidification technology that would be incorporated, should Alternative 2 be selected, is proven and efficient. A letter referencing over 20 proven applications of the solidification technology was sent to the Club and is on file in the repository located in the Nola Brantley Memorial Library in Warner Robins.

18. A letter from the Ocmulgee Sierra Club stated that they suspect the base has no intentions of cleaning up other waste sites and is not acting in a responsible manner.

Robins AFB Response: Robins AFB is concerned about its past disposal practices and is acting in a responsible and cooperative manner with all regulatory agencies. The purpose of the proposed plan was to describe the options for treatment and/or control of contaminated media for the source control remedial action at the Zone 1 National Priorities List (NPL) site.

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